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*E.W. Hanlon  
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## CONTRIBUTORS TO VOLUME III.

---

**BELFIELD, WILLIAM T., M. D.,**

Associate Professor of Surgery in the Rush Medical College; Professor of Genito-Urinary and Venereal Diseases in the Chicago Polyclinic.

**DAVIS, EDWARD PARKER, A. M., M. D.,**

Professor of Obstetrics in the Jefferson Medical College and in the Philadelphia Polyclinic; Obstetrician to the Jefferson, Philadelphia, and Polyclinic Hospitals.

**FOWLER, GEORGE RYERSON, M. D.,**

Professor of Surgery in the New York Polyclinic; Examiner in Surgery, Medical Examining Board of the Regents of the University of the State of New York; Surgeon to the Methodist Episcopal and German Hospitals; Surgeon-in-Chief to the Brooklyn Hospital; Consulting Surgeon to the Relief Hospital and to the Bushwick Hospital, Brooklyn.

**FRAZIER, CHARLES H., M. D.,**

Professor of Clinical Surgery in the University of Pennsylvania; Surgeon to the University and Philadelphia Hospitals.

**INGALS, E. FLETCHER, M. D.,**

Professor of Diseases of the Chest, Throat, and Nose in the Rush Medical College; Professor of Laryngology and Rhinology in the Chicago Polyclinic; Laryngologist to the Presbyterian Hospital and to St. Joseph's Hospital, etc.

**KYLE, D. BRADEN, M. D.,**

Clinical Professor of Laryngology in the Jefferson Medical College; Consulting Laryngologist, Rhinologist, and Otologist to St. Agnes' Hospital, Philadelphia.

**LEONARD, CHARLES LESTER, A. M., M. D.,**

Demonstrator of Surgery in the University of Pennsylvania.

**MCCOSH, ANDREW J., M. D.,**

Clinical Lecturer on Surgery in the College of Physicians and Surgeons, New York; Visiting Surgeon to the Presbyterian Hospital.

**MARTIN, EDWARD, A. M., M. D.,**

Professor of Clinical Surgery in the University of Pennsylvania; Surgeon to the Philadelphia, St. Agnes', and Howard Hospitals; Consulting Surgeon to the Bryn Mawr Hospital and to the State Hospital for the Insane, Norristown, Pa.

**MATHEWS, JOSEPH M., M. D., LL. D.,**

Professor of Surgery and Clinical Lecturer on Diseases of the Rectum in the Hospital College of Medicine, Louisville; Visiting Surgeon to the St. Mary and Elizabeth Hospital; Consulting Surgeon to the Louisville Hospital and the Jennie Cassady Free Infirmary for Women; late President of the Mississippi Valley Medical Society; President of the Louisville Clinical Society; President of the Kentucky Board of Health; Ex-President of the American Medical Association.

**MONTGOMERY, E. E., M. D.,**

Professor of Gynecology in the Jefferson Medical College; Gynecologist to the Jefferson Medical College Hospital and the St. Joseph's Hospital; Consulting Gynecologist to the Philadelphia Lying-in Charity and the Kensington Hospital for Women.

**RANSOHOFF, JOSEPH, M. D., F. R. C. S., ENGLAND,**

Professor of Anatomy and Clinical Surgery in the Medical College of Ohio; Surgeon to the Cincinnati, Good Samaritan, and Jewish Hospitals, Cincinnati.

**SPENCER, GEORGE W., M. D.,**

Demonstrator of Surgery in the Jefferson Medical College, Philadelphia.

**SMITH, S. MACCUEN, M. D.,**

Clinical Professor of Otology in the Jefferson Medical College; Surgeon in Charge of the Ear and Throat Department, Germantown Hospital, Philadelphia.

**WHARTON, HENRY R., M. D.,**

Clinical Professor of Surgery in the Woman's Medical College of Pennsylvania; Surgeon to the Presbyterian and Children's Hospitals; Consulting Surgeon to the Bryn Mawr Hospital; Fellow of the American Surgical Association.

**WOOD, CASEY A., M. D.,**

Professor of Clinical Ophthalmology in the University of Illinois; Professor of Ophthalmology in the Post-Graduate Medical School; Ophthalmic Surgeon to the Passavant Memorial Hospital, Chicago.

## ANÆSTHESIA AND ANÆSTHETICS.

By CHARLES LESTER LEONARD, M. D.

THE discovery of anæsthesia marks one of the epochs of surgery. The avoidance of the pain and shock of surgical intervention was the great object attained; while, in addition, the patient was placed completely under the control of the operator. The pain and shock of surgical operations were often more serious dangers to the patient than the operation itself. Thus, where operation is necessary upon a patient suffering from heart disease, unless a local anæsthetic can be employed, the dangers from the pain and shock of the operation are greater than those from the anæsthetic when carefully administered. On the other hand, operation upon a healthy individual is often more dangerous under incomplete anæsthesia than it would be without any anæsthetic. This is because the semi-anæsthetic state lowers the inhibitory power of the cerebral centres, and thus dangerous reflex impulses are created by the operative injury inflicted on the peripheral sensory nerves.

During the continuance of anæsthesia the safety of the patient must always be the chief consideration, and must be the guide in the choice of an anæsthetic. Any estimate of the relative value of the various anæsthetics, from the clinical standpoint, must be based upon their safety, and must comprehend not only the immediate dangers that arise during their administration, but also the remote effects resulting from their toxic action.

There are two sources of danger that should not be confused in estimating the clinical value of the different anæsthetic agents: those due to the drug and inherent in it, and those resulting from its administration by the average anæsthetist. The average administrator must be considered in estimating their relative clinical value, and not the expert.

The drugs that are most frequently employed in producing general surgical anæsthesia are nitrous oxide gas, ether, and chloroform. They are inhaled as gases or vapors, and enter the circulation through the lungs. They are most usually given separately. They are, however, sometimes combined in mixtures, and may be given with advantage in succession, as where nitrous oxide is used to induce anæ-

thetia, which is then continued by the administration of ether. The administration of either of these anæsthetics combined with pure oxygen has decided advantages, but requires special apparatus, which as yet is cumbersome and not readily applicable to general use.

Nitrous oxide is a mixture of nitrogen and oxygen according to the chemical formula  $N_2O$ . Its most convenient form, as found in commerce, is in the liquid state, in steel cylinders compressed under about thirty atmospheres of pressure. It has decided anæsthetic properties, and should be given without producing the asphyxic symptoms to which its anæsthetic power has frequently been attributed. Its anæsthetic period is of very short duration, and although, when administered with repeated admixtures of air, or in combination with pure oxygen, the anæsthetic state can be prolonged, it is, on the whole, unsatisfactory for major surgical operations. It is most frequently employed for the painless extraction of teeth and for minor surgical operations that are of momentary duration.

Ether is a transparent, colorless, volatile liquid, having a burning taste and a characteristic, penetrating odor. It is the result of the action of strong sulphuric acid on strong alcohol at a temperature of  $260^{\circ}$  to  $300^{\circ}$  F. It has the chemical formula  $(C_2H_5)_2O$ , and a specific gravity of 0.723 at  $54.5^{\circ}$  F., and boils at a temperature of  $95^{\circ}$  F. It is highly inflammable, and is explosive if ignited when mixed with air. This makes it necessary to observe caution, when it is being used, not to approach too near an artificial light or flame, and to avoid the use of the actual cautery before the ether cone is removed and the vapor fanned away.

The high specific gravity of ether makes it, however, easy to avoid these accidents. Its vapor sinks to the floor and permits the use of lights so long as they are held above the ether cone and the bottle. Ether for anæsthesia should be chemically pure and free from water or alcohol, which are the more common impurities. They can be detected by adding the oil of copaiba, which fails to form an emulsion with pure ether, but will do so in the presence of these impurities.

Clinical experience has shown that ether is the safest anæsthetic known for prolonged anæsthesia. Its toxic and dangerous effect is upon the respiratory centres, while it has a stimulating action on the heart. It is less rapid in its action than chloroform, and consequently the danger threatening can be recognized and the proper remedy applied before serious injury results. It should, however, be remembered that, although it is the safest anæsthetic known, it possesses toxic properties, and is a drug which should be administered in doses sufficient to produce the desired anæsthesia, and no more. When larger amounts are employed than are absolutely essential to complete surgical anæsthesia, the effect is seen in an added shock,

which is out of all proportion to the severity of the operation, and can only be attributed to the toxic action of the overdose of ether upon the system. The practice of "soaking" the patient with ether because it is the "safest anæsthetic" cannot be too severely condemned. When due care is taken to administer only the amount which the individual case demands, and the method of administration is carefully studied, ether will be found to be not only the safest anæsthetic, but also the most satisfactory to patient, surgeon, and anæsthetizer, and free from many of the sequelæ attributed to it.

Chloroform is a transparent, colorless, volatile liquid, having the formula  $\text{CHCl}_3$ . Its odor is not unpleasant, though penetrating, while the taste is sweet and persistent. Its specific gravity is 1.497 when 1 per cent. of ethylic alcohol is added to preserve it. It is best kept in a dark-colored glass, as light decomposes it, and the resulting vapors are very irritating. When administered where artificial open lights are required its vapor is decomposed and has a decided and annoying irritant effect on the respiratory system of operators and assistants. Chloroform for anæsthetic purposes should be absolutely neutral to test-papers. It should be non-irritating when inhaled and of an agreeable odor. If allowed to evaporate, no residue should remain. There should be no discoloration when shaken with concentrated sulphuric acid. No precipitate should form with solutions of nitrate of silver.

The toxic action of chloroform is not confined to the respiratory centre, although its action upon this centre after prolonged anæsthesia may result in respiratory failure. It also acts upon the circulation, either directly upon the heart through the coronary arteries or through the vasomotor system, causing dilatation of the capillaries and fatal syncope, the patient's respiration failing because of the failure of sufficient blood to reach the respiratory centres.

The dominant action of chloroform on tissue is depressing; coming in contact with the heart, even in medicinal doses, it weakens that organ, while it lowers the vitality of the protoplasm of the respiratory centre in a ratio proportionate to the amount of the drug inhaled.

Death from chloroform may result in three ways, but is always due to circulatory or respiratory failure. In the first stage, during the patient's struggles, the holding of the breath raises the intrathoracic blood-pressure and congests the venous system, while the arterial tension is lowered. The deep inspiration fills the patient's lungs with chloroform; and the heart, which has been emptied, is surcharged with blood rich in chloroform. The depressing action of the drug upon the tissues of the heart takes place by the penetration of this surcharged blood into the coronary arteries, and the result is a paralytic dilatation and engorgement. This is the primary form of heart-

failure. The secondary form is the result of the poisoning of the cerebral centres after prolonged anæsthesia by the chloroform in the circulation; or it may be the result of the anæmia produced by the dilatation of the capillaries. The same is true of respiratory failure. It may be due to direct poisoning of the medullary centres by the chloroform in the circulation. It is more frequently the result of an anæmia which the chloroform produces by its toxic action on the vasodilator centres. A dilatation of the capillaries results in the draining of the blood from the whole body into them and an anæmia of the brain. The patient thus dies by being bled to death into his own capillary system. This form of syncope is, of course, facilitated by the sitting or semi-recumbent position.

It is very essential to recognize the form of syncope that has occurred, as the methods employed in its treatment are almost diametrically opposite. In the one, the engorged heart must be emptied and freed from the blood that is surcharged with chloroform and stagnating in the semi-paralyzed organ. In the other, the failing innervation, the result of the cerebral anæmia produced by the capillary dilatation, must be overcome by producing a temporary congestion. In both the excess of chloroform must be removed and replaced by a reoxygenation of the blood by the employment of artificial respiration.

The most reliable statistics seem to show that ether is more than five times as safe as chloroform. There is 1 death in 3162 anæsthesias produced with chloroform, and 1 in 16,302 produced with ether. Undoubtedly, therefore, ether is the safer general anæsthetic for prolonged operations. While nitrous oxide is the safest, it is impossible to perform under it any but very brief operations, and none where relaxation of the patient and absolute freedom from motion are essentials.

When the diverse circumstances under which anæsthesia must be produced, and the vast number of patients who must place their lives in the hands of unskilled operators are considered, the slowness of the action of ether compared with the rapidity of the action of chloroform is a factor that cannot be overlooked. The patient is carried in all general anæsthesias close to the border-line between life and death by the employment of drugs possessing very active toxic properties. The drug which has the most uniform and reliable action, and has the least dangers connected with its administration, is ether; and it is, therefore, the drug which should be employed wherever it is possible. Undoubtedly, chloroform in the hands of the expert is free from many of the dangers attributed to it; but ether under similar conditions would be even safer. The first duty is to secure the safety of the patient, rather than his convenience or that of the operator.

Careful administration will diminish to a minimum not only the immediate risk of death, but also the toxic effects, which are capable

of adding materially to the shock produced by the operation. The slow succession of the various stages during etherization is of material advantage to the novice. The presence of danger can be detected when sufficient time yet remains to ward it off. Ether is undoubtedly the anæsthetic to teach the student to give. When he has mastered it he will have acquired that caution which is bred of experience, and will have learned that he is always in the presence of danger no matter which anæsthetic he is employing. He will then be fitted to administer the more dangerous drug, chloroform. It is the constant watchfulness which the realization of the actual danger fosters that is the patient's greatest safeguard.

In selecting an anæsthetic the particular case in hand and the operation to be performed must always be considered. If the operation is short and can be done while muscular rigidity is present or the patient is restless, nitrous oxide is the safest anæsthetic, and the one which is the freest from unpleasant after-effects. It can be used in all cases in which simple incisions are all that is required, as in opening abscesses or sinuses; breaking up adhesions; making painful examinations; and in performing many minor operations that are quickly executed.

Ether, when properly administered, will be found to have few contraindications, and should be employed in preference to chloroform in every case in which it is possible. There are very few patients and very few operations in which it cannot be given satisfactorily, especially if preceded by the administration of nitrous oxide. When its greater safety is considered, the slight inconveniences met with are of little moment. If safety is permitted to outweigh the minor considerations of discomfort and unpleasantness that are mostly due to poor administration, the reasons for using chloroform narrow themselves down in the majority of cases to the self-interest of the operator in saving time. The nausea that follows ether administration is not greater than that which often interrupts chloroform-narcosis. The deaths that are attributed to a pneumonia resulting from the effects of the ether should in the majority of cases be attributed to the negligence of the anæsthetizer. Vomited matter is permitted to pass into the trachea or into the lungs, and a septic pneumonia results; or the patient is unduly exposed when depressed by the shock of the operation and anæsthesia.

There are certain patients whom it is impossible to anæsthetize with ether with sufficient rapidity or to a proper degree. It may be necessary in these cases to resort to chloroform, but it should be replaced by ether as soon as possible. Chronic disease of the kidney has been considered a contraindication to ether-anæsthesia. Undoubtedly ether is excreted by the kidneys, but recent research has shown



that the severely injurious effects attributed to it are rarely, if ever, seen when the ether is administered in a dosage just sufficient for surgical anæsthesia.

In operations upon the face and mouth chloroform, administered by employing a Junker's inhaler and passing the tube through the mouth or nares, is most certainly a very convenient method. The same result, with much less danger to the patient and but little more inconvenience to the operator, can be achieved by etherizing the patient deeply just before the operation is to begin; then the ether can be entirely removed, and a considerable time will elapse before the patient recovers sufficiently to interfere with the operation. If continuous deep anæsthesia is desired after the operation commences a very small amount of ether will suffice to keep him under. The specific gravity of the ether permits it to be given in a sufficient quantity after the patient has been deeply anæsthetized by holding a gauze sponge saturated with ether above the patient's nose. The vapor is then inhaled through the mouth or nares. Many operators, however, prefer to have the patient in a semi-conscious condition, so that they are able to clear the throat of blood or mucus. The task of the anæsthetist is then more difficult.

The claims made for chloroform in anæsthesias for laparotomies are far too great. Ether when correctly administered is capable of maintaining as uniform an anæsthesia, more free from sudden recoveries, and with less tendency to vomiting than chloroform. The fault has been in the method of administration, or rather in the mal-administration.

There are undoubtedly patients who are unsuited for ether-anæsthesia, but no fixed rule can be laid down by which they can be determined. There are also certain operations that can be more conveniently performed under chloroform. Where an exceptional case is found in which ether seems unsuited, then chloroform may be used, but with a full recognition of its depressant action on tissue and the serious dangers that are run. Ether, because of its stimulant action on the heart and respiratory system, should be used in all cases in which depression and heart-failure have to be combated.

**Preparations for Anæsthesia.**—The preparation of the patient for operation lies, in a general way, in the province of the attending surgeon or regular physician. Unless, however, certain precautions are taken, the patient's condition may seriously interfere with the administration of the anæsthetic and lead to grave complications. The best hour for operation, when the choice can be had, is at a regular meal-time or shortly after. At this time the patient's stomach is habitually empty, and the abstinence from food can be borne with less danger of weakening the patient. The necessity for administer-

ing foods at irregular hours is eliminated, and also in a greater measure the danger from indigestion and the persistence of undigested residue in the stomach. When it is impossible to operate early in the day, between 8 and 9 A. M., which is a time when the patient is naturally refreshed by sleep and with an empty stomach, the next best hour is 1.30 or 2 P. M. If the later hour is determined upon, the patient may be allowed a light breakfast; but it is better to abstain entirely when the strength permits, and to be content with a cup of coffee or a dish of clear hot soup. This is better than milk, which is liable to remain undigested, especially in those not accustomed to its use. If there is a great amount of shock or decided weakness, a nutrient enema may be given half an hour before the operation, except, of course, in operations upon the intestines. The nutrient enema may consist of the yolk of an egg, an ounce of beef-juice, and an ounce of milk, all to be peptonized, and then an ounce of brandy added. The intestine should be washed out with warm water before the enema is given.

Lavage of the stomach has been highly recommended as a preventive of vomiting in cases in which the operation has to be performed without a chance to prepare the patient, and in which the stomach is full of undigested food. It seems particularly applicable to cases of intestinal obstruction, in which fecal vomiting is to be feared, and experience has shown that there is always grave danger of a septic or inspiration pneumonia. Lavage is, however, often followed by collapse in healthy subjects; but the risks which accompany emesis during the administration of an anæsthetic are even greater than this chance. The lavage may be employed while the patient is under the anæsthetic, just after complete anæsthesia has been secured, and thus collapse is entirely avoided.

When, for any reason, it is impossible to regulate the diet of the patient or to perform lavage, the greatest caution should be exercised when vomiting ensues. When ether is the anæsthetic that is being administered the vomiting can be checked if its onset is recognized. It is a reflex phenomenon, and can only occur during the second stage, when the patient is not fully under the influence of the anæsthetic, and never when reflexes are abolished, in the stage of true surgical anæsthesia. The first indication of an attempt to vomit should be answered by more ether, and by abolishing the reflexes the emesis can be prevented till the end of the anæsthesia. In children especial caution is necessary, for the hastily purloined forbidden food has been quickly swallowed, is most surely undigested, and a large piece may easily fall into the larynx and block it. If vomiting comes on in the early stages before the reflexes have been abolished, it is best to yield to the inevitable. Under all circum-

stances the patient's head should be turned on one side, or he may be turned completely over; but if the cheek is placed upon the pillow the vomitus then flows along the side of the pharynx, passes the larynx without going over it, and flows out on the inner side of the cheek.

Examination of the urine should be made before all surgical procedures, and it is always well for the anæsthetist to know what the examination has revealed. It is also best for the urine to have been voided shortly before the anæsthesia. This is particularly true of nitrous oxide anæsthesia, in which the urine is often involuntarily voided as the result of spasmodic muscular action.

The condition of the bowels should be carefully attended to and a thorough evacuation secured by administering calomel the second night before the operation, followed by a saline or an enema the day before. If it has been necessary to give the calomel the night before the operation, a thorough and complete evacuation should be secured early on the morning before the operation. It should always be definitely determined that any enema employed has been effectual.

FIG. 1.



Mouth-gag.

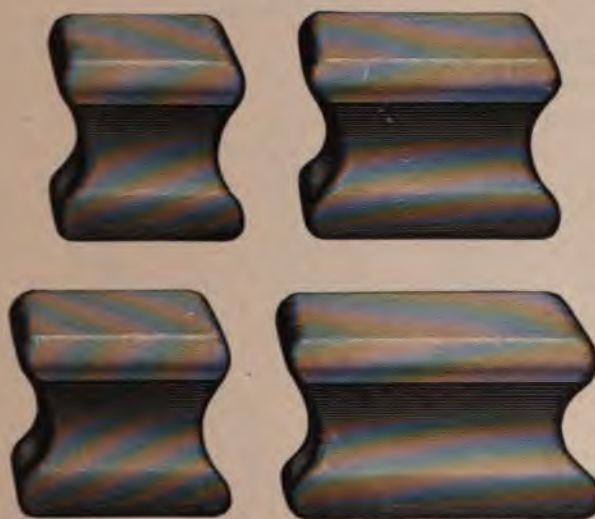
The greatest care should be taken to maintain the patient's bodily temperature at the normal, and to prevent chilling, either during the anæsthesia or while the patient is being removed to the bed. This attention should comprise the care of the personal clothing, the blankets, and the artificial heat. The patient should be prevented from being wet with antiseptic solutions, or other fluids, by properly placed rubber blankets and by the position and incline of the table.

The position and comfort of the patient while on the table should receive the particular care of the anæsthetizer. The table should be comfortably padded, and the bad habit of assistants of resting themselves on the unconscious patient should be discouraged. Un-

doubtedly patients suffer after the operation, often in excess of what is absolutely unpreventable, because these details are not given sufficient attention.

Before commencing the administration of the anæsthetic the anæsthetizer should be sure that he is provided with all the apparatus, instruments, and drugs that he may require, or that they are within easy access. Besides the apparatus appropriate to the administration of the particular anæsthetic he is to employ, he should be provided with a mouth-gag (Fig. 1), soft-rubber bite-blocks (Fig. 2), tongue-

FIG. 2.



Bite-blocks.

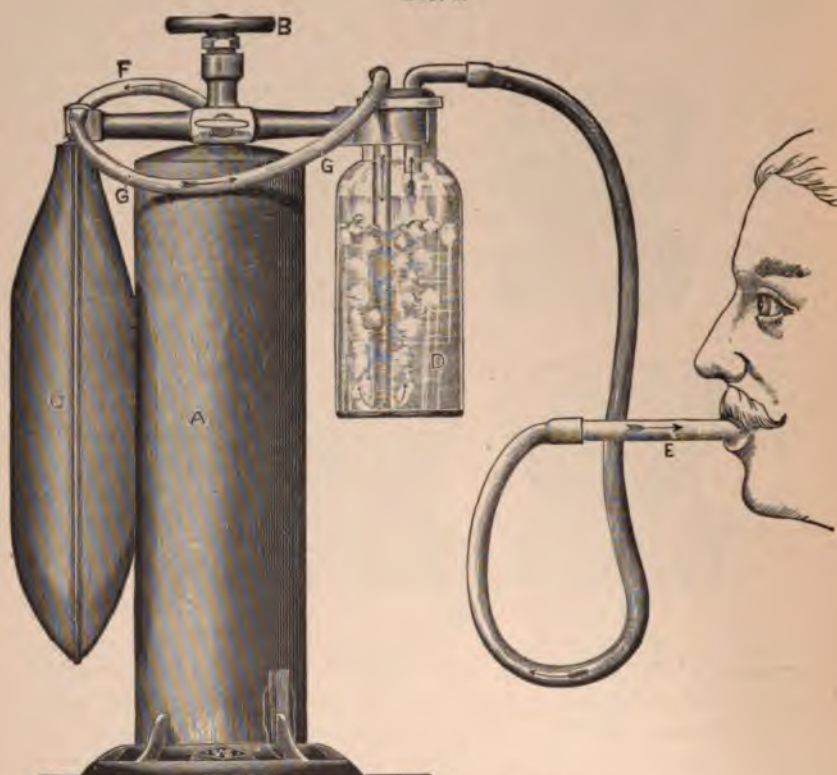
forceps a cylinder of oxygen, with apparatus for its administration (Fig. 3), a hypodermic syringe in good working order, and solutions of known strength of strychnine sulphate, digitalis, and atropine. An electric battery should also be readily accessible if it should be required.

Before commencing the administration of any general anæsthetic a routine physical examination of the patient should be made. The examination can commence as soon as the anæsthetizer sees the patient. Psychical impressions exert a marked influence in anæsthesia. The mental attitude of the patient toward the anæsthetizer plays an important part in rendering the administration easy and agreeable to both patient and operator. In order to obtain the best results the patient's confidence must be secured, and to do this an estimate of the character and a correct judgment regarding the nature of the individual must be formed, that the psychical impression may be made

agreeable to the peculiarities of the individual. The gaining of patients' complete trust and confidence allays the fears of the anæsthetic and permits them to place themselves unreservedly in the care of the anæsthetist.

The routine physical examination of the heart, arteries, and respiration, and the inquiries regarding false teeth and foreign bodies in the mouth, are absolutely essential to the safe conduct of each anæsthesia ;

FIG. 3.



Apparatus for the administration of oxygen.

but they can be done, and should be always done, in a manner that does not alarm the patient. Although they are routine to the anæsthetizer, they are novel and awe-inspiring to the timid patient who is to be anæsthetized for the first time. A remark as to the regularity of the pulse and the strength of the heart, and the fact that such an examination is always made of each patient, will go far toward removing the fear. The losing of consciousness through artificial means, by the employment of drugs, has often serious terrors for the novice. If the suggestion is made to a timid woman that she loses



consciousness every night, and that this is nothing more, her fear will be somewhat lessened. If a man is told that the action of ether is analogous to that of whiskey, he will understand and believe it harmless far sooner than if authorities are quoted.

The loosening of all constricting bands of clothing and corsets should always be insisted on, no matter how brief or trifling the anæsthesia and operation. It is impossible to tell what the emergencies in any particular case may be or how soon artificial respiration may be required. The removal of false teeth or of foreign bodies from the mouth is absolutely essential. The presence of a false eye in a patient, brought to the hospital unconscious after an accident, has caused much anxiety to the operator. The previous administration of opiates or stimulants should be determined before the anæsthesia is commenced.

#### THE ADMINISTRATION OF NITROUS OXIDE GAS.

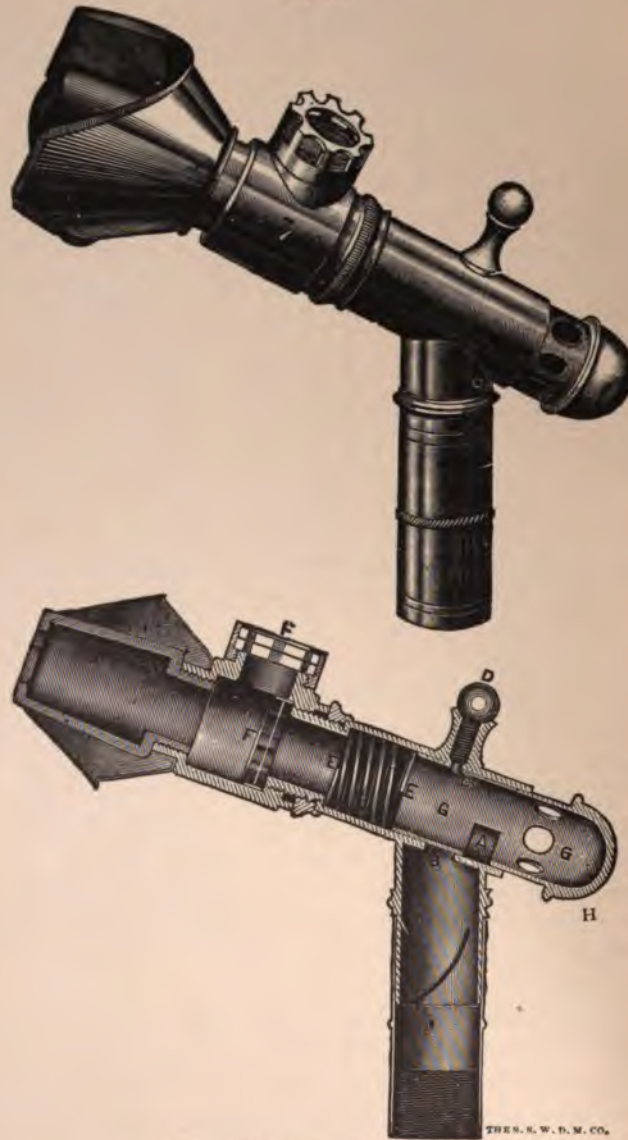
Nitrous oxide is most frequently administered for the performance of dental surgery. It can, however, be applied in minor surgical practice with great advantage, and its use in inducing anæsthesia which is to be continued by ether in major surgical interventions is fast becoming the method of choice. When these anæsthetics are administered in combination with pure oxygen the anæsthesia secured approaches perfection in the absence from unpleasant complications and serious sequelæ.

Nitrous oxide and ether are the only anæsthetic agents that can be administered with safety with the patient in the sitting posture. The method of administering nitrous oxide which was formerly in vogue, and is still generally employed, combined with the anæsthetic action of the nitrous oxide the production of a measure of asphyxia. It is, in fact, comparable to the closed method of ether-anæsthesia produced by the use of the Clover or Ormsby inhaler. The true anæsthetic action of the nitrous oxide gas was obscured by the asphyxic phenomena which its poor administration produced. Its administration without the production of asphyxic phenomena, either by the admission of air or by its admixture with oxygen, has proved it to have true anæsthetic properties, and has shown that the best effects can be produced by one or other of these methods.

The administration of nitrous oxide with a sufficient amount of air is accomplished in the following manner: after insertion of a suitable soft-rubber bite-block (Fig. 2), if the operation is to be performed in the mouth, the metal face-piece (Fig. 4) is placed in position. The patient is told to inspire deeply and fully, and is permitted to inspire air until accustomed to the face-piece, the air passing in and out through a valve provided for this purpose. The nose

is then held gently with the thumb and index finger of the left hand, while the right, by pressing on the tube, shuts off the air and forces

FIG. 4.

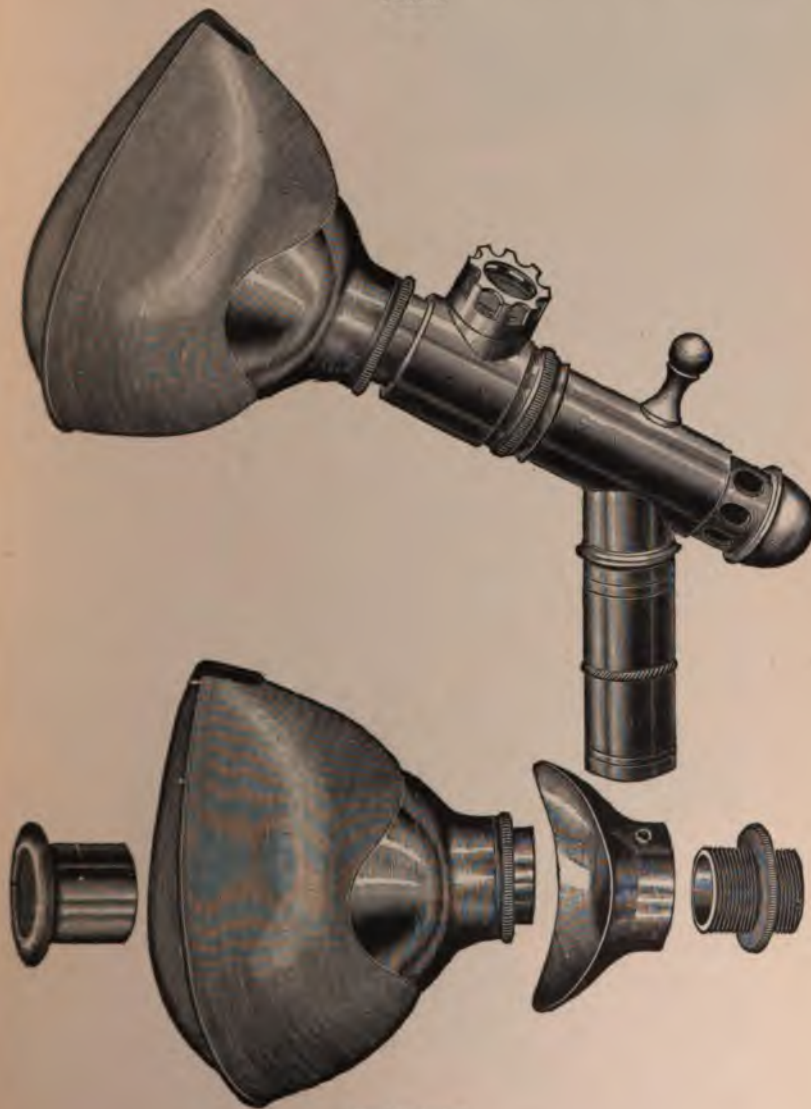


Nitrous oxide inhaler. Metal face-piece.

the patient to inspire the nitrous oxide. The amount of air mixed with the gas can be regulated by the pressure on the valve, and should be so adjusted that all but the slightest trace of cyanosis is

absent. When the anæsthetic is administered in this way the livid blueness of cyanosis is wanting, and but a slight blue tinge, or rather pallor, of the lips is all that need be produced. Stertor, muscular

FIG. 5.



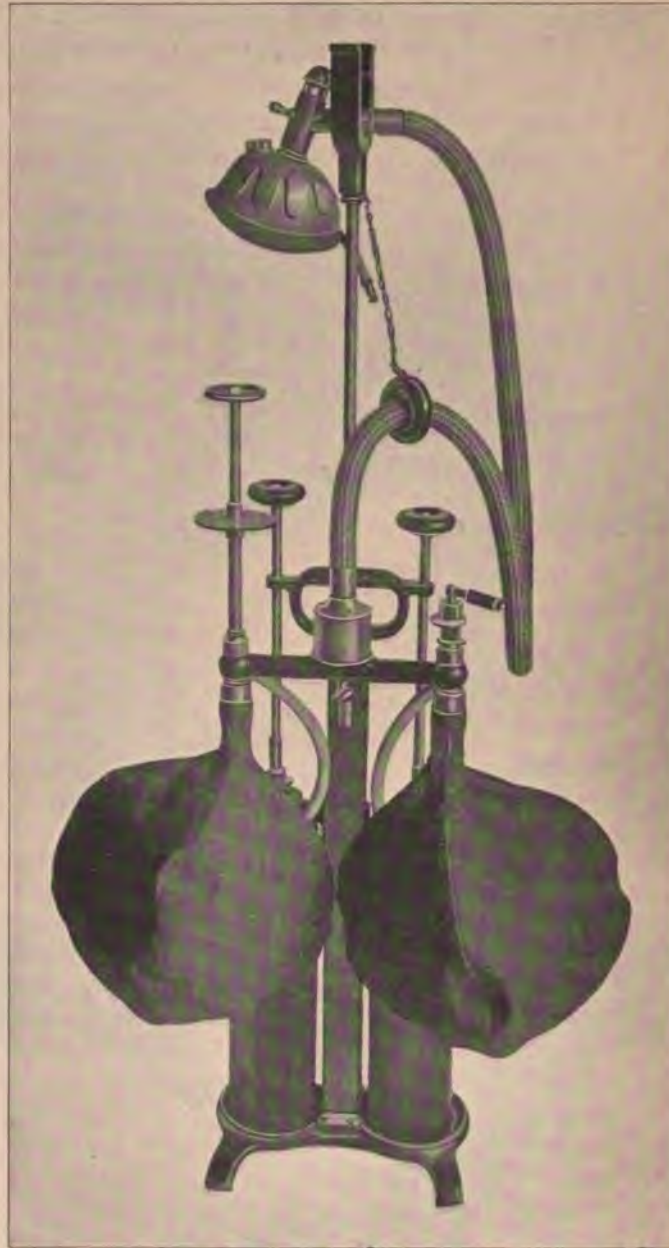
Hood inhaler.

twitchings, jactitations, and pharyngeal spasmodic contractions are entirely avoided.

This method of administration can be carried out with a simpler face-piece, or rather a large hard-rubber tube of the calibre of the



FIG. 6.



Nitrous oxide and oxygen apparatus.

tube connecting with the gas-bag, and having a simple valve. This tube is placed in the mouth and the patient told to inspire deeply.

The stop-cock is not opened at first, but the patient is allowed to inspire pure air. The nostrils are then gently closed by the thumb and finger, while the gas is turned on. The patient inspires the nitrous oxide gas and expires it around the tube. The amount of air is regulated by the flow through the nose during inspiration, and is guided by a careful observation of the color of the lips. Cyanosis and bluish discoloration of the face are not permitted to appear, the amount of air allowed counteracting any tendency in this direction.

FIG. 7.



Portable nitrous oxide apparatus.

The older, or close, method of administering nitrous oxide consisted in the complete exclusion of all air by the employment of a soft-rubber or pneumatic face-piece (Fig. 5), such as is employed in the administration of nitrous oxide and oxygen. The regulating valve is the same, and the difference in its employment is that so soon as the patient is accustomed to deep inspiration with the mask in place all air is cut off, and the patient inspires pure nitrous oxide. The phenomena observed differ considerably, for we have the combination of asphyxic phenomena with those of nitrous oxide anaesthesia. The first few inspirations of the pure gas are followed by a change in the color of the face: it grows darker, and finally becomes of a deep, dusky hue, of uniform lividity. The snore of anaesthesia is quickly followed by a harsh laryngeal stertor and twitchings of muscles that

become occasionally violent jactitations. They are a sign of profound anæsthesia and asphyxia. These later symptoms of twitching muscles or of laryngeal stertor are the guide to sufficient anæsthesia. The discontinuance of the anæsthetic now takes place, and a period of surgical anæsthesia of from forty to fifty seconds' duration remains before returning color and normal breathing show that the asphyxia has been overcome and the patient has regained consciousness.

The administration of nitrous oxide with oxygen has the same advantages as the administration with air. The freedom from as-

FIG. 8.



Complete apparatus of Dr. Hewitt for administering mixed nitrous oxide and oxygen.

phyxial symptoms is more marked, and when the proportion of oxygen is properly adapted to the individual case the result is ideal. The difficulty is the cumbersome apparatus required. The accompanying illustration (Fig. 6) shows the form of apparatus generally employed in this country. The amount of oxygen admitted to the mixing-chamber is regulated by a valve which is directly under the control of the administrator. The proportion which is said to be the nearest to the general average is about 10 per cent. of oxygen. This amount is, of course, greater during the commencement of the anæsthesia, and



When using the apparatus the precaution should be taken to fold the pipe tightly before admitting the gas, so that it does not become filled with air. This is especially necessary when the closed, or facial, method is employed. The face-piece must also be made to fit snugly. As in all other anæsthesias, the apparatus should be carefully tested before the operation commences, and two cylinders of gas should always be on hand, to make certain of a sufficient supply.

The patient should be carefully guarded against occlusion of the trachea by foreign bodies, and all precautions taken as if any other anæsthetic was to be employed. Asphyxia is the danger to be guarded against, but patients are never so fully anæsthetized when dangerous complications present themselves that they do not recover by ordinary means after the removal of the anæsthetic. Circulatory failure and cerebral hemorrhage are of rare occurrence, but have been noted.

The after-effects from nitrous oxide anæsthesia are very trifling, and the patient rapidly recovers with no persisting evidences of the anæsthesia.

#### THE ADMINISTRATION OF ETHER.

The preparation of the patient and the preliminary examinations required have been fully dealt with under the general considerations. In the administration of ether particular attention must be paid to the respiratory and circulatory systems. The stimulant action of ether upon the respiration and heart has a marked advantage over chloroform, with its depressant action in these cases. The active stimulation must, however, be considered in a slightly adverse light in certain respiratory and cardiac pathological conditions. They, however, should not be considered contraindications, but should be regarded upon as demanding greater care in the administration, as little

traindication ; but among the thousands of aged patients anæsthetized with ether we find no deaths recorded as the result of complications dependent upon this cause. The same conditions seem to have far more contraindications for the administration of chloroform, with its known cardiac depressant action. While emphysematous and tubercular conditions of the lungs contraindicate the "soaking" of the patient with ether, they are strong indications for its careful administration. The stimulating effect of ether is very valuable in these asthenic conditions. The depressant action of chloroform is dangerous: it is depressant when administered in any dose. Ether is depressant and injurious only when it is administered in toxic or overdoses.

The objection to ether on account of its irritating action on the bronchial mucous membranes can be entirely overcome and the chance of these effects obviated by employing nitrous oxide and oxygen to induce anæsthesia, and continuing it by the careful administration of just sufficient ether. Ether, however, when properly administered will be entirely satisfactory in the majority of these cases. Undoubtedly the unfavorable symptoms recorded as the result of ether-anæsthesia are, many of them, due to the asphyxic element of the close method of inhalation, in which the patient does not secure sufficient oxygen or air in connection with the ether inhaled, and in which the congestion which results from the asphyxia increases the chronic congestion or the acute inflammation of the respiratory pathological process from which the patient is suffering.

The phenomena seen during the administration of ether may be described, when viewed from the clinical standpoint, as follows, dividing them for convenience into three principal stages : first, that of consciousness, in which the patient is capable of all voluntary movements and can hear and appreciate all that is going on around him ; second, that of semiconsciousness, in which, although there are complete muscular relaxation and loss of voluntary motion, there are still present reflex motion and sensation, with a dulled and distorted perception of sound ; and, third, the unconsciousness, or true anæsthetic stage, in which consciousness, sensation, and even the reflexes, except the deeper ones, are entirely under the control of the anæsthetic.

The objects of anæsthesia, as has been stated, are the abolition of pain or sensation, the abolition of reflex inhibitory stimulation (through the abolition of reflexes), and the complete relaxation of the patient, so that the surgeon is in complete control. The first of these objects is only attainable by the abolition of reflex phenomena ; so long as the patient is a recipient of reflex stimulation he is capable of feeling pain. The reflexes must be abolished for another reason. Reflex stimulation has been found capable of giving rise to centric

stimulation of the inhibitory centres of sufficient strength to cause serious and even fatal results. This is undoubtedly more liable to occur with chloroform, yet it is a danger that should not be disregarded in operations done under ether. The setting of fractures, the reduction of dislocations, and the breaking up of adhesions can be done during the second stage, in which muscular relaxation is present although the reflexes have not been abolished. Cutting operations, especially upon the perineum, should be avoided before the reflexes are abolished.

The examinations necessary before the administration of an anæsthetic have already been described. The condition of the

FIG. 9.



Position of patient during anæsthesia. Head extended and carried anteriorly. (Orig.)

lungs and heart, with the arteries, should be noted carefully before etherization, as, being forewarned, any accident that might occur is more readily avoided and the appropriate measures adopted. The patient should lie upon the table with the head somewhat raised but not flexed. The position assumed should resemble that of a runner with the head carried forward and slightly extended (Fig. 9). The pillow should be partly beneath the shoulders. This position has been shown to insure an open glottis and prevent closure of the pharynx by the falling down of the soft palate upon the tongue. The patient should be warned that the first few breaths of ether will

be irritating, and that he may feel a choking sensation before he goes to sleep, but that that will all pass away before he loses consciousness. If not warned that these sensations are to be expected, they will so frighten him that all the confidence gained will be speedily dissipated.

The first, or conscious, stage of the anæsthesia may be divided clinically, for convenience, into three periods. In the first we have the irritation as the most prominent symptom; in the second the patient becomes accustomed to the inhalation, and we have a period of calm; in the third the stimulating and exhilarating action of the ether is in evidence, and we have the period of excitation.

In commencing the etherization the object should be to overcome as far as possible the irritant effect of the ether, by diluting it with air until the mucous membrane becomes accustomed to it. This is accomplished by holding the ether-cone at a distance from the patient's face and gradually approaching nearer and nearer; or the cone may be applied immediately, the patient permitted to draw a few breaths of air through it, and then the ether added drop by drop. This method, though requiring a little more time, affords sufficient comfort to the patient to compensate for the delay. The patient should be instructed to "blow out hard," as he will not inspire deeply if requested. He will blow out hard, and as a consequence must take a full, deep inspiration.

As soon as the irritation period has passed, and the patient is breathing naturally and well, the concentration of the ether vapor should be increased by placing more on the cone. This is the only period when it is justifiable to "soak" the patient. The concentration of the ether vapor just at this period, before the excitation commences, is of great value, as it rapidly anæsthetizes the patient and cuts short the period of excitation, which is so exciting to the patient and has such ill effects upon the circulatory system. By thus forcing the ether at this period the excitation period will be shortened, and often abolished, so that it is only noticeable in an excited respiratory action or a deep, sighing inspiration. If, by some pleasant word, a smile has been brought to the patient's face before the anæsthesia commenced, it will be now seen in the reflected smile of the excitation period, and we will know that the psychical influence has been exerted, and that the patient is having pleasant dreams.

Such a result is not without its value, as patients who have been forced under the influence of an anæsthetic, and held on the table during the excitation period, have endured great agony in the disturbed dream of the ether sleep, and not alone then, but in specific instances it has been known to last for nights in succession, the recurring dream disturbing their sleep. The exhibition of marked



excitation, unless the patient is addicted to alcoholic stimulants or is particularly robust and healthy, is generally a mark of poor anæsthetization, and can be accounted for by the mixing of too much air with the ether during the period of calm. The mixing of air with ether in this stage means increase of excitation.

The relaxation of the patient follows the more or less brief period of excitement. It is generally ushered in by the commencement of the ether-snore. This shows the relaxation of the soft palate that thus partially occludes the air-passage, and produces the sound similar to that heard during deep sleep.

The second stage passes without marked incident. The relaxed patient lies upon the table incapable of voluntary motion but semi-conscious. As has been stated, this is the stage for setting fractures and dislocations, and for breaking up adhesions. The amount of ether required to keep the patient in this stage of anæsthesia is very small; he may be allowed to come back till he recovers voluntary motion, and again deeply anæsthetized, without the exhibition of the phenomena incident to the first stage.

The third, or last, stage of surgical anæsthesia is divided from the second stage by the complete abolition of reflexes except the deep or habit-reflexes. The reflexes most generally employed in etherizing a patient are the conjunctival and the laryngeal. The conjunctival reflex is of the utmost delicacy, and should be tested with care, and not too frequently. Whenever any motion, except that of respiration, is visible it is unnecessary to test for this reflex. The closure of the eyelid when attempting to take the conjunctival reflex is sufficient to make the more delicate test unnecessary. This reflex is obtained by gently touching with the pulp of the finger, having care not to touch with the nail or with a soiled finger, the palpebral or sclerotic conjunctiva. The result of this stimulation is seen in the puckering of the lower lid as it is drawn (as by a gathering thread) toward the inner canthus of the eye. Care should be taken not to move the lower lid with the finger that raises the upper one to reach the conjunctiva. Any such motion would, of course, vitiate the value of the observation. The laryngeal reflex is the result of the irritation of fresh ether vapor on the mucous membrane of the larynx. When fresh ether is added to the cone over the face of a patient whose reflexes are present the vapor irritates the mucous membrane, and the result of the reflex stimulation is seen in a swallowing movement of the larynx. This reflex is nearly as constant as the conjunctival, and is valuable in confirming it, or when it is impossible to get at the conjunctiva.

The presence or absence of reflex is distinctive of the stage of the anæsthesia: it is the dividing-line between the reflex, or semi-con-



scious, and the unconscious; between the annoyances of etherization and the grave dangers. Any complication occurring during etherization, except occlusion of the air-passages, if reflexes are not abolished, is only a complication, and is never grave in character; since, while reflexes are present, cessation of the respiration from centric paralysis cannot ensue. It is, therefore, safe in these conditions to push the ether until by the abolition of all reflexes the complication is overcome. The respiration must always, however, be free. Any complication occurring while these reflexes are absent is dangerous, and demands the immediate withdrawal of the anæsthetic, with careful attention to the respiration until the reflexes return, or the immediate application of artificial respiration if there is a tendency toward cessation or even enfeeblement.

After the abolition of reflexes and the commencement of the true anæsthetic stage the guide to deeper anæsthesia is the condition of the pupil. In normal anæsthesia the pupil contracts to light-stimulus, till at the commencement of the surgical stage of anæsthesia it is the size of a common pin's head. After the abolition of the conjunctival reflex the pupil gradually dilates, as the patient is carried deeper and deeper into the third, or anæsthetic, stage. This dilatation of the pupil is, however, governed in a measure by the reaction to light or the absence of light. The occlusion of the eyes, so that no light reaches them, produces wide dilatation. When light is readmitted the pupil contracts, but not to the same extent that it would under a like light-stimulus where the ether was absent. It contracts only to the point to which it has been dilated by the ether. The effect of the ether is thus to prevent the complete contraction of the pupil rather than to dilate it. It prevents the normal amount of contraction, the amount of dilatation depending on the depth of the anæsthesia. It is generally safe, where deep anæsthesia is demanded, to dilate the pupil to one-half of its maximum diameter, but it is not necessary to dilate it at all in ordinary cases. All the conditions of surgical anæsthesia are fulfilled as soon as reflexes are abolished, when the pupil is of a pin's head size under bright light-stimulation. The patient should, in general, be kept in this condition and with the use of as little ether as possible. It will be found that very little ether is required to keep the patient in this condition, with the reflexes abolished, for any length of time. During abdominal operations the pupils should, in addition, be kept slightly dilated. By using the pupils as a guide in these operations, in which the return of reflexes and vomiting would seriously inconvenience the operator, the patient can be kept safely etherized without being pushed too deeply. The ether should be added only as needed. It should not be poured on, and the patient pushed deeply under its influence and then allowed

to recover. This is only permissible when the operative intervention demands the cessation of the anæsthetic for a time, as in operations on the mouth.

The chief attention of the etherizer should be given to the respiration. Ether kills by its toxic action on the respiratory centre. The breathing, however, should be watched, not because of the toxic action of the ether, but to prevent interference with free respiration, and as a guide to anæsthesia. The breathing should be heard or felt, not seen. All the motions of the thorax seen in respiration can be made and yet the larynx be completely closed. The ether vapor exhaled pours out of the cone, and by reason of its great specific gravity falls over the hand of the etherizer. The interrupted waves of cold vapor can be readily felt by the hand. The ether-snore is generally so marked that any alteration in respiratory rhythm is quickly heard, and the deep, sighing inspiration tells the anæsthetizer that the patient needs more ether. Frequently, however, when the ether is well given the breathing is so quiet that the operator must exercise care in detecting the respiration. The hand placed before the mouth will readily detect it.

The use of the mouth-gag, tongue-forceps, etc., often seen during anæsthesia, is a mark of poor etherization rather than of great carefulness on the part of the etherizer, and shows that the anæsthetic has not been well administered since it demands such aids. With the patient placed in the position described above, with the head carried anteriorly and slightly extended, there will be no need for these implements. The tongue does not fall back unless the etherization has been carried too far. The soft palate does not occlude the airway, nor does the pharyngeal wall become so relaxed as to interfere with respiration. If they do, it is not necessary to draw the tongue forward by forceps, except in cases of very grave toxic ether-effects, when the patient is nearly paralyzed. The tongue will lie quietly in the mouth, but the relaxation of the muscles in deep anæsthesia may permit the whole anterior pharyngeal wall to sink posteriorly. It is not, however, necessary to drag the hyoid bone anteriorly by traction on the tongue. If the fingers are placed behind the angles of the jaw, on the ascending rami, and the jaw is carried anteriorly, which can be readily accomplished under full relaxation, the ligamentous attachments of the hyoid bone to the mental symphysis insures the carrying anteriorly of the entire pharyngeal wall with the hyoid bone. This traction also draws upon the hyo-epiglottic ligament, raising the epiglottis and opening the larynx. If there is any tendency to vomit, the head should be turned on the side and the vomitus permitted to flow around the larynx on the side of the pharynx and on the inner side of the cheek out of the mouth. This

anatomical method of raising the epiglottis and opening out the pharynx is shown in the accompanying illustration (Fig. 10).

The *pulse* should be taken from time to time in ether-anæsthesia, to note the general condition of the patient and the amount of shock from the operation. It is at first liable to be rapid from excitement, and the administrator should judge of the case at first rather by the pulse recorded on the chart with the history, than by the pulse just previous to the commencement of the anæsthesia. The

FIG. 10.



Drawing the hyoid bone and attached pharyngeal structures forward by anterior traction on the inferior maxilla. The fingers posterior to the ascending rami, the thumbs on the mental symphysis, pushing it downward and opening the mouth.

pulse should generally fall after the anæsthesia is commenced, and the stimulant action of the ether should be felt in its increased volume and strength. In uncomplicated cases, in which the pulse was about normal before operation and the operation is not severe in character, the pulse should not rise above 90 or 100 at most; and often, even after a prolonged anæsthesia, it is just where it commenced. In other words, ether properly administered should have no effect in raising the pulse-rate; all such alteration should only be due to operative shock. Much of the shock that has been attributed to operative intervention can be directly traced to the toxic effects of the anæsthetic administered in larger doses than is absolutely essential to perfect anæsthesia. The raising of the pulse in operations that are

of themselves not liable to produce shock can usually be accounted for if the ratio of the amount of ether employed to the length of the anæsthesia is studied. When the pulse is found in an adult to be small, compressible, and between 140 and 150 per minute, the indications are for the administration of strychnine. It should be given hypodermically in  $\frac{1}{15}$  grain dose, to a healthy adult, and repeated once if the condition of the pulse demands it after a half-hour interval. As has been said, it should be the anæsthetizer's business to know what drugs the patient has received just previous to the anæsthesia, and how much. The administration of pure oxygen, either in respiratory complications or where the results of shock are in evidence, will be found of great benefit. Where the patient is in a collapsed condition or already seriously shocked the administration of ether with oxygen is strongly to be recommended, if a general anæsthetic is imperative.

The stages of ether anæsthesia are practically the same no matter what form of apparatus is employed in administering it, if plenty of air or oxygen is given to the patient at the same time. The closed method of inhalation combines with these phenomena those in a measure of asphyxia, and the clinical picture is therefore somewhat modified. The stages are reached more rapidly with a smaller amount of ether employed. The effect upon the patient cannot, however, be as good as when the open method or that with the admixture of the necessary amount of oxygen is employed. When the closed method is employed with the use of the Clover or Ormsby inhaler the anæsthetizer should avoid the asphyxic symptoms as far as possible, by admitting air beneath the mask when the signs of asphyxia are visible. The method is not frequently employed in this country, and can only be recommended when modified by the employment with oxygen.

**Apparatus for Ether Administration.**—The simplest methods are generally the best, and the most elegant method of administering ether with the greatest comfort to the patient is by the drop method on a piece of folded sterile gauze. A pad about five by seven inches, made of eight or ten thicknesses of gauze, is formed into a cone effect by placing a three-cornered fold in each end of the pad and fastening it with a safety-pin. This arrangement keeps the gauze and cold ether above the patient's nose and lips, and permits the vaporization of the ether within it. It can be easily inverted, so that the freshly saturated side comes within. The method is, however, expensive. The old-fashioned towel and paper cones are to be avoided; sufficient air does not reach the patient, and the anæsthetization is rendered very uncomfortable.

The Allis inhaler (Fig. 11) is a very valuable instrument, and



economizes ether while rendering the patient comfortable. Care should be taken to have the flannel bandage, upon which the ether is poured, wound on sufficiently close, otherwise the too great admixture of air is liable to increase the excitation and make it difficult to keep the patient under the influence of the ether. The metal frame must, of course, be sterilized and rewound for each anæsthesia.

FIG. 11.



Allis's inhaler.

A convenient and cheap method of producing similar results has lately been devised. It consists in taking a strip of cardboard six inches wide and about eighteen inches long, and bending it into a form similar to that of the Allis inhaler. It is held in this position by a rubber band or a strip of adhesive plaster. One end is covered with sterile gauze that dips in an inch and a half or two inches. This pocket is then filled with crumpled gauze and covered over with another sheet of gauze. The different layers can be held in place by the rubber band or adhesive plaster. The end applied to the patient's face can be bound with adhesive plaster after it has been cut to fit the nose. The cone thus formed is cheaply made, highly satisfactory in its results, and economical of ether. A fresh cone can be readily made for each patient, and destroyed after it has been used.

A convenient drop-bottle is arranged by cutting grooves on opposite sides of a cork from one end to the other. The air enters by one groove and permits the ether to flow out through the other. Or a rubber cork can be employed having in it two glass tubes, the extremities of which are bent in opposite directions. The Roberts's ether bottle is probably the best device that can be obtained. It prevents evaporation and spilling, even when the bottle is laid down, and yet the ether flows readily when required.

Where it is necessary to etherize a patient through a tracheotomy-tube, as in operations upon the pharynx or larynx, a device, which the author has found perfectly satisfactory, is to obtain a rubber tube

three or four feet long that will fit closely into the inner canula. At its other end an ordinary glass funnel is fitted, and holds some crumpled gauze. If the funnel is now held at a lower level than the tracheotomy-tube, the rubber tube forms an S shape. If the ether is carefully administered there is no irritation of the bronchial mucous membrane; and the anæsthetizer, standing well outside of the operative field, can be guided in the administration of the anæsthetic chiefly by the respiratory movement. A suitable swab must be at hand to clear the tracheal tube of mucus as it collects.

The excessive secretion of mucus in operations on the mouth or œsophagus can be in a great measure controlled by administering  $\frac{1}{150}$  grain of atropine before the commencement of the anæsthesia. After the tracheotomy has been done the larynx and pharynx, with the œsophagus, should be plugged with gauze sponges securely held by ligatures. Blood and mucus are thus prevented from entering the larynx or œsophagus, and the interference with respiration and the tendency to vomiting they are liable to induce are prevented.

In the administration of *nitrous oxide* and *oxygen*, followed by *ether* and *oxygen*, special apparatus, as shown under Nitrous Oxide, is required. Although there are a number of forms of apparatus devised for making the change readily from nitrous oxide to ether and oxygen, they are more or less crude and awkward in their application. The administration of the two gases (nitrous oxide and oxygen) in combination is readily accomplished; but the methods of vaporizing ether and mixing it in the requisite amount with oxygen are as yet unsatisfactory. The simpler method of accomplishing the same result is practically that recommended in the administration of nitrous oxide—that is, the employment of the oxygen in the air instead of pure oxygen. Pure oxygen is, however, a stimulant to respiration, and of great value where asphyxic symptoms are to be overcome which have resulted from the administration of an anæsthetic, and it should always be at hand.

A record of all ether administrations should be kept, especially in hospital work, and can conveniently be kept by employing a blank similar to that shown in Fig. 12, which the author has introduced at the Philadelphia Hospital. The stub remains in the etherizer's book, which when filled is filed away, while the detachable blank is filed with the history-sheet. Ready reference can thus be had to the effect of the anæsthesia upon the patient if a subsequent anæsthesia should be required, while the data collected are valuable for reference.

**The After-treatment of the Patient.**—The recovery from ether-anæsthesia is often prolonged, and it is absolutely necessary that the patient be carefully watched during the recovery. As a general rule, the anæsthetizer should not leave his patient until the return of con-





of course, obviated and the former lessened by the careful preparation of the patient for the ether. The tendency to vomit can be decreased and vomiting checked in many cases by the exhibition of vinegar or dilute acetic acid. It should be poured on a piece of gauze and held before the patient's face, so that the vapor is inhaled. The anæsthetizer should, of course, test the strength of the vapor himself before administering it to the patient. Vomiting before the patient has regained consciousness should be treated as during anæsthesia. The head should be turned to one side, and, if necessary, the jaw brought forward and the mouth opened. The tendency of patients who have been etherized to suffer from pneumonia is probably exaggerated, and is attributed to the wrong source. They should, however, be guarded from taking cold, as their relaxed condition undoubtedly renders them more susceptible.

**The Complications of Ether-anæsthesia.**—The accidents that occur during the administration of ether are, in the majority of cases, due to some defect in the method in which it is given. There are, however, certain individuals who are predisposed to exaggerate the unpleasant symptoms that arise in the various stages of the anæsthesia.

In the first, or conscious, stage the elements that tend to produce unpleasant, and even dangerous, symptoms are the terror of the patient, the rigidity of the muscular system (which comes on as a sudden spasm), and the asphyxial symptoms that may be due to this spasm or the result of the lodging of a foreign body in the larynx. All of these complications can be avoided in the majority of cases. The patient should never be forced to take the anæsthetic. Often the first breath or two bewilders a patient, so that false impressions are liable to lead to mental excitement. If the patient is permitted to return to consciousness, the hallucinations can be readily dispelled and the ether continued without the dangers that follow where the resistance is overcome by force. Fright has been known to cause fatal arrest of the heart. Muscular rigidity and spasm are also in a great measure the result of too hasty administration. The struggling patient has ether poured upon the cone, the concentration produces marked irritation, and a spasm results. When spasmodic contraction and rigidity of the muscles take place in the early stage of anæsthesia, they are best overcome by temporary withdrawal of the anæsthetic, and its continuance in less concentration after relaxation has taken place. An annoying tremor that is sometimes an unpleasant complication and renders operation difficult can be overcome by permitting the patient to return to the first stage, and then repeating the anæsthesia. It may be necessary in some instances to repeat this procedure two or three times before the tremor ceases, but it will succeed if persisted in sufficiently long. If vomiting threatens during the first



stage, it is generally best to suspend the anæsthesia until it is over, and to wash out the patient's mouth before readministering the anæsthetic. Vomiting during the operation should not be permitted, and can be prevented by "pushing" the patient under the influence of the anæsthetic and abolishing the reflexes. If during the commencement of the anæsthesia there is an excessive secretion of mucus, it may be more difficult to anæsthetize the patient. It is often well in these cases to permit the patient to recover sufficiently to swallow, when the mucus will be removed. In the later stages it is only necessary to allow the reflexes to return for this to be accomplished. As has been pointed out, the administration of atropine tends to diminish the amount of mucus secreted, but it is essential to remember in such cases the effect upon the pupil.

The dividing-line which separates the annoying complications from the dangerous in narcoses, is formed by the superficial reflexes. Their presence or absence is the basis for the differentiation of the dangerous from the annoying. While the respiration is free and full, deviation from the normal course of the anæsthesia is not dangerous if the superficial reflexes are still present. On the other hand, their absence converts any alteration into a danger. The guides to complete and proper surgical anæsthesia are the breathing and the reflexes, with sufficient attention to the circulation to determine the effect of the operation and anæsthesia. The pulse does not need to be watched so closely in the open method of ether-administration, nor are there frequent changes in the color of the patient. These, however, are signs that are not without their significance, but in ether-administration they generally point to an interference with the respiration, and not with the circulation.

In the third, or complete surgical anæsthetic stage, in which the superficial reflexes are abolished, any alteration from the normal demands immediate suspension of the ether and an examination of the air-passages to make certain that there is no interference with proper breathing. Very frequently a test of the reflexes will show that the patient is returning to the second stage, and that all that is demanded is more ether.

Failing respiration demands the removal of the anæsthetic, the clearing of the throat, and, if the patient does not breathe more freely, the commencement of artificial respiration. If there has been much loss of blood by the operation, or through the accident that has made it necessary, the foot of the table should be raised, and, if necessary, the limbs and abdomen bandaged. This is not as necessary with ether as with chloroform, for we do not have with it the depressant action on the vasomotor centre and the consequent dilatation of the capillaries. It may be well at this point to warn against

the resumption of the horizontal position too rapidly after the patient has been anæsthetized in the Trendelenburg position. Serious syncope has followed a too sudden lowering of the extremities in a number of cases that have come under the author's observation.

The reversed motion of the diaphragm under toxic doses of ether is worthy of mention. Instead of the normal motion, it hangs relaxed when the ether is pushed too far, through paralysis, and the inspiratory movements of the thorax draw it upward, causing a retraction of the abdomen.

FIG. 13.



Artificial respiration. Sylvester's method. First position, completed expiration.

After the removal of the anæsthetic in threatened failure of respiration the tongue should be brought forward either by the anatomical method, by means of the attachment to the jaw, as described above, or by the direct traction by means of forceps. In drawing the tongue out with forceps care should be taken not to draw it over the teeth of the lower jaw, which not only injures it, but also is ineffective in producing the desired result. It should be drawn upward as well as outward, just avoiding the upper teeth. Traction in this direction will act directly on the hyoid bone, and through it on the anterior pharyngeal wall and the epiglottis. Stimulation of the respiration often results from dashing of ether upon the bared abdomen. It can also be stimulated by Laborde's method of rhythmical traction upon

the tongue. This method is readily applicable to all cessations of respiration from whatever cause. Laborde found that when the tongue is firmly grasped, as with forceps, or by the fingers covered with a towel or handkerchief, or when the hyoid bone is drawn anteriorly by hooking the finger back of the base of the tongue, if rhythmical traction is made respiration is reflexly stimulated. The traction exerted must not be constant, but rhythmical at the rate, in the adult, of eighteen tractions per minute, corresponding to the normal inspiratory rhythm. The purpose of the traction is to draw

FIG. 14.



Artificial respiration. Sylvester's method. Second position, semi-inspiration.

the hyoid bone anteriorly, and as a consequence a reflex stimulation is exerted upon the respiration. If the motion is given by traction upon the tongue, it must be pulled upward and outward, as noted above, and not downward over the lower teeth.

In performing artificial respiration the patient should be brought well to the head of the table. The shoulders and neck should be raised by a pillow, and the head allowed to fall into an extended position (Fig. 13). The raising of the head and neck above the level of the trunk insures the patency of the respiratory passages, while the extension of the head, by producing an upward traction on the hyoid bone, raises the epiglottis, opening the larynx so that air can readily



rush in. The extension of the head by permitting it to fall over the head of the table insures the passage of any vomited matter beyond the larynx, and thus avoids the dangers incident to inspiration of septic matter into the lungs. The pillow under the shoulders also acts as a fulcrum, increasing the efficiency of the enforced inspiratory movement.

Figs. 13 to 16 depict the sequence of motion in the Sylvester method. In the first position, the air is expelled from the lungs by pressure upon the thoracic wall by the pressure of the patient's arms upon the thorax as they are forced downward. The inspiratory

FIG. 15.



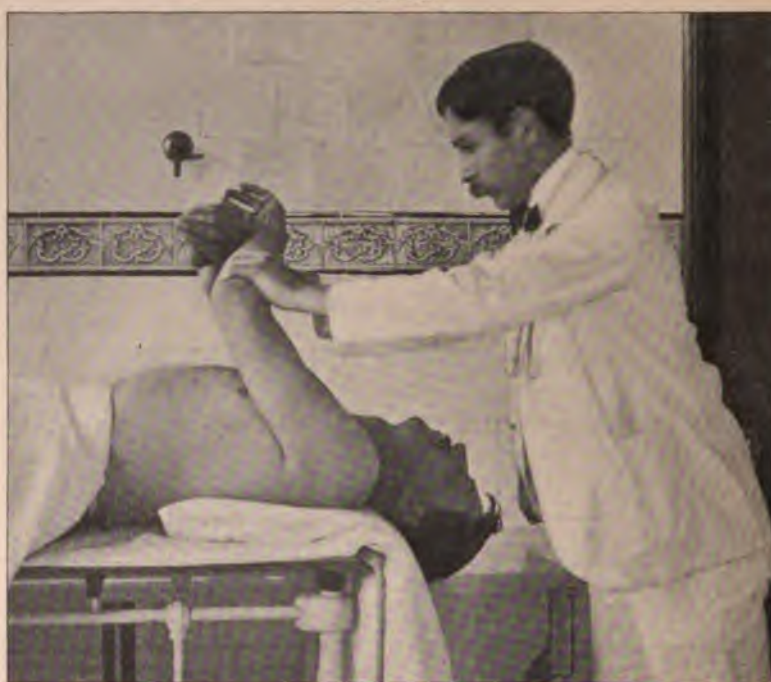
Artificial respiration. Sylvester's method. Third position, completed inspiration.

movement is produced by carrying the arms outward and upward (Fig. 14) in the transverse plane of the patient's body until they meet above the head (Fig. 15) at a point which corresponds to complete inspiration. Here the pectorals and other muscles of inspiration are put upon the stretch and the thoracic cavity expanded to its utmost capacity. A slight pause should be made at this point before expiration is produced. The arms are then carried downward in planes passing anteroposteriorly through the body (Fig. 16) until the cycle of respiration is completed and the first position reassumed. These movements should not be executed hurriedly, but in the time of normal respiration, seventeen or eighteen to the minute. A good guide is the operator's own respiratory rhythm.

The administration of pure oxygen through a simple tube placed in the mouth or nostril, depending upon which direction the inspiratory flow takes, will be found of undoubted value, as the amount of oxygen taken into the system will be materially increased.

Forced inspiration by the employment of intubation-tubes and air pumped in by an ordinary bellows has been suggested, and proved by experiment to be a valuable method of resuscitating patients suffering from asphyxia. The introduction of an ordinary soft-rubber

FIG. 16.



Artificial respiration. Sylvester's method. Fourth position, semi-expiration.

catheter into the larynx has been suggested as a substitute for intubation, and has the advantage of simplicity of apparatus. It has also been suggested that the operator can blow through this catheter, thus forcing air into the patient's lungs. As a substitute for these methods, the author would suggest the employment of the pure oxygen apparatus. It is now generally admitted that a cylinder of oxygen should be among the apparatus prepared for the anæsthesia. By attaching the oxygen tube to the soft-rubber catheter inserted in the larynx the pressure of the liberated oxygen can be employed to distend the lungs, can be readily controlled and the pressure shut off when expiratory pressure is made upon the thorax.



The intravenous injection of normal salt solution is a valuable adjunct in cases in which there has been great loss of blood. It is also of value in stimulating the circulation. Saline solutions may also be introduced into the rectum, but should be hot in either case ( $105^{\circ}$  F. at least). Strong coffee for the rectum is, however, preferable as a stimulant. Alcoholic stimulation is not valuable in ether-narcosis, as the action is very similar to that of the ether, and increases rather than decreases the effect. In chloroform it may be used, but its employment must depend upon the condition and strength of the heart, and whether it is capable of sustained action. Strychnine, as has been already stated, is the best stimulant we possess of the respiration, while digitalis should be employed for the weak and failing heart that demands strength rather than stimulation. Nitrate of amyl should be avoided, because of its action on the vasodilator system.

#### THE ADMINISTRATION OF CHLOROFORM.

As has been pointed out in the general remarks upon anæsthetics, chloroform is a depressant. Its action upon the tissues and cerebral centres is depressing. Its dominant action is seen in depressing the vasomotor centres, causing dilatation and fatal syncope by the withdrawal of sufficient blood from the cerebral respiratory and cardiac centres. In continued anæsthesia its toxic, depressing, dominant action may be exerted directly upon these centres, and produce either cardiac or respiratory failure as a consequence. Undoubtedly vasomotor failure is the more frequent cause of death under chloroform, but there is also no doubt that the cardiac failure may be the primary, or both may occur so nearly together that it is impossible to decide definitely which was primary, while both must be held responsible for the fatal termination.

These brief considerations of the action of chloroform emphasize the fact that in its administration the anæsthetizer must ever be on the alert, and have that practical education which enables him to detect immediately any variation from the normal of either cardiac or respiratory action.

The chief concern of the anæsthetist in the administration of chloroform should be with the respiration, to see that the patient gets sufficient air; and under no condition should the vapor of chloroform form more than 4 per cent. of the inhaled air. In this regard chloroform and its mixtures vary absolutely from ether and nitrous oxide, where saturation with the vapor is often desirable.

The preliminary preparation of the patient for chloroform-narcosis is practically the same as in ether, as already described. In addition, the irritant action of the chloroform vapor upon the skin of the face

must be prevented by the application of vaseline just prior to the administration.

As with all anæsthetics, concentration of the vapor is to be avoided in commencing: and with this agent the greatest care should be observed. With the other agents concentration produces annoying symptoms; with chloroform, concentration always produces dangerous symptoms.

When the administration is commenced the cloth upon which the chloroform is dropped, one drop at a time, should be held at least five inches from the face; and it should under no circumstances be approached nearer than two inches; and a large quantity of chloroform should never be poured on at once. Drop by drop, literally, is the best method, with the drop timed to fall at the commencement of inspiration.

The stages and symptoms of anæsthesia are practically the same as those described under ether-administration. They succeed each other, however, more rapidly, and the dangerous conditions also come on and reach a critical point with much greater rapidity. Chloroform should never be pushed during the struggling of the excitation-stage. The danger of a forced inspiration of saturated chloroform-vapor in the struggling and its confinement in the lungs and absorption into the circulation have already been dealt with in detail. Relaxation of muscles follows excitation, and is in turn followed by loss of reflexes and complete surgical anæsthesia. The color of the face, and the volume, rapidity, and quality of the pulse, must be constantly watched, and the slightest variation noted and its cause determined. Only by constant attention to such detail and alertness in detecting and combating threatened dangers can the safety of the patient be assured under chloroform-narcosis. Any other method of administration is foolhardy, and subjects the patient to grave risks and complications, that, detected late, can only have a fatal termination. The pupillary reaction does not conform to the general conditions found in ether-anæsthesia, and cannot be taken as a guide in pushing the anæsthetic. The reflexes are also not always abolished, nor is it always justifiable to demand their complete abolition. The respiration and the pulse must be the main guides during the narcosis. The reflexes and relaxation of the patient are, of course, indications of the completeness of the anæsthesia, but their continued absence cannot always be insisted upon. Thus annoying complications, as threatened vomiting, cannot be overcome with the same freedom by pushing the anæsthetic, and so soon as complete narcosis is secured the anæsthetic should be withdrawn. This method of administration permitting the patient to breathe free air is valuable in etherization, and tends to lessen shock; with ether, however, recovery from the anæsthetic

does not take place so rapidly and the patient is under better control.

In operations upon the face and within the mouth and throat chloroform is considered more convenient, because so little is required and it can reach the patient when held at a distance without obstructing the operative field. The advantage gained does not counterbalance the increased danger of the anæsthetic nor the annoyance which operation in the recumbent position gives, instead of the sitting posture, which can be maintained throughout the entire operation if ether is used. The danger of administering chloroform to a patient in the sitting or semi-recumbent position cannot be too frequently nor too emphatically insisted upon. The depressant action of chloroform upon the vasomotor centre has been proved, and that fatal syncope results from the dilatation of the capillaries and the withdrawal into them of the blood from the cerebral centres. Such a result would, of course, be favored by any position in which the head is raised or the limbs are dependent. The head must, therefore, be kept at its proper level, and any symptom of syncope or failure of respiration, or of cardiac action, must be immediately counteracted by lowering the head and raising the feet. When this does not suffice the limbs should be compressed by tightly applied bandages, which may also compress the abdomen. When artificial respiration is required, if the respiratory and cardiac failure is the result of syncope and the anemia is the result of vasomotor dilatation, the elevation of the feet and compression of the limbs and abdomen with bandages should form a part of the means employed to resuscitate the patient.

In the first stage of chloroform-anæsthesia we have seen that cardiac failure may result from the direct toxic depressant action of the chloroform upon the cardiac muscle. This is brought about by the overcharging of the heart with blood supersaturated with chloroform and its passage into the coronary arteries. The muscle of the heart is paralyzed, and it is found dilated and engorged with blood. The treatment of this state must include the emptying of the heart of the blood it contains, and the continuation of the patient's respiration by artificial means to replace the chloroform in the blood by pure oxygen or the oxygen of the air. The heart can be emptied often by directly compressing the thorax over the cardia by forcible pressure exerted by an assistant, while artificial respiration is being carried on. The pressure should be made during the expiratory movement. Another method which has been suggested and found valuable consists in lowering the patient's feet and placing him in a semi-erect position while pressure is made over the heart, thus bringing in the action of gravity, and then returning the patient to the horizontal position and continuing artificial respiration. In this par-



ticular form of heart-failure, which occurs in the first stage, it is not necessary to raise the feet. There has been no dilatation of the capillaries, no mechanical anæmia of the cerebral centres to be corrected, and the production of a hyperæmia is not demanded by the condition present. When syncope has caused the cardiac and respiratory failure, as in the later stages, a mechanical hyperæmia is to be produced during the artificial respiration by position, by compressing the limbs with bandages, and by pressure on the floating ribs and abdomen, forcing the blood from the dilated capillaries and from the splanchnic area.

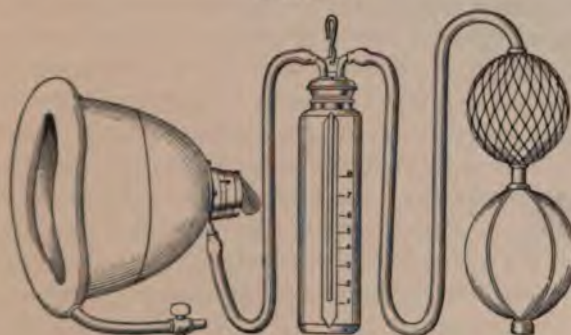
It has been observed that accidents under chloroform are less liable to occur in warm climates, as in India, and this has suggested the following precautions as adding safety to the administration of this anæsthetic: To operate in well-ventilated rooms at a temperature not under 70° F. To produce anæsthesia gradually; to dilute with plenty of air—never giving over 4-per cent. of chloroform; to watch the respiration closely; to test the reflexes frequently when no voluntary movements are visible, and to observe the patient's pulse and color, and the condition of the pupil; to keep the respiratory channels free from obstruction; to place the patient always in a supine position with the limbs never lower than the trunk; never to add more chloroform in struggling, but to give more fresh air.

**Apparatus for the Administration of Chloroform.**—The essential feature of chloroform-administration is the dilution with air; as a consequence the apparatus required is of the simplest character. The corner of a towel or handkerchief held with a safety-pin, or a little wire frame covered with flannel or gauze—in fact, any object upon which the drops of chloroform rapidly spread and become volatilized and diffused in the air—is all that is required. Various forms of apparatus have been devised to mix the chloroform mechanically with air in known proportions. They have none of them accomplished their object accurately, and those that have approached most nearly to absolute accuracy have been valueless because so complicated or cumbersome. The Junker apparatus (Fig. 17) is the most nearly accurate in combination with portability. The air is pumped through the chloroform and, mixing with its vapor, is carried on to the mask and to the patient. In attaching the tubes to the chloroform reservoir care should be exercised to make the attachment correctly, as fatal results have followed the pumping of the pure chloroform into the mask. The most valuable employment of this apparatus is found when the mixed air and chloroform vapor are introduced into the respiratory passages, either nose or mouth, through a suitable tube. The other apparatus is very similar to that used in the open method of etherization. The chloroform

bottle should be of dark glass, and so arranged that it will drop accurately, that it can be closed completely, and that the cork will not fall out.

The accidents other than those dealt with in connection with its administration are similar in chloroform to those met with in ether,

FIG. 17.



Junker's inhalator for chloroform.

and the same principles of treatment are applicable. Stimulants can be more freely employed, but amyl nitrite should be avoided, as it increases vasomotor dilatation and the dangers consequent thereto.

#### MIXTURES OF ANÆSTHETIC AGENTS.

The general principle may be laid down in regard to mixtures that they must be used as cautiously as the most dangerous drug they contain. Many of them are liable, if not considered in this light, to give a false sense of security and render the anæsthetizer less cautious than he should be.

The A. C. E. mixture is the mixture which is considered most reliable. It should be freshly made of one part of alcohol, two parts of chloroform, and three parts of ether. The phenomena produced by its administration are possibly not exactly what would be expected from the mixture of ether and chloroform, and it is claimed that the anæsthesia is safer and that the first stage is induced more rapidly. It is often used in place of nitrous oxide or chloroform to induce anæsthesia which is continued later with ether.

The complications and dangers are, however, those met with from chloroform rather than from ether. The administration must be gradual, the concentration not too great. The respiration must be carefully watched, and also the color of the face and the condition of the circulation. It must be used in small quantities, by the drop method.

The mixture may be administered by any of the open methods employed with ether if care is taken to admit sufficient air with the

vapor of the mixture. An Allis or some similar form of inhaler is probably best.

**The Administration of Morphine with Anæsthetics.**—The combined narcosis produced by the administration of morphine with a general anæsthetic has been recommended and employed by various surgeons whose word has great authority. Such a practice is justifiable in certain cases, but should not become a routine practice. The susceptibility of patients varies greatly to morphine, and the effect of the anæsthetic in combination with it is also very variable. The greatest objections advanced against its employment are that it masks the symptoms and signs of danger arising from the anæsthetic; it alters the secretions, and many surgeons strongly object to it on account of its after-effects upon the patient. There is undoubted evidence of grave complications having been produced by this combination, and the anæsthetist should always be careful to ascertain whether the patient, as in hernia or abdominal operations, is under the influence of an opiate.

If morphine is to be administered in a given case, it should be determined previously what its action alone is upon the patient; and if it is to be administered just before the operation, inquiry should be made regarding any previous administration. The combination is recommended in cerebral operations as rendering the brain more anæmic, and in operations on the mouth and face, in which the ether-narcosis must be interrupted.

If morphine is employed, it is best given hypodermically twenty minutes before the anæsthesia is commenced, in a dose of  $\frac{1}{8}$  to  $\frac{1}{4}$  grain, according to the previously determined susceptibility of the individual. The general anæsthetic must be given with great caution, as much less is needed and the stages succeed each other with greater rapidity. This caution must also be observed where a patient previously under morphine has to be anæsthetized. The action of morphine upon the pupil must be remembered, and this guide in a measure abandoned. It is not, however, as essential to abolish the reflexes, as the patient is not as susceptible to reflex stimulation nor as sensitive to pain. The author has seen a patient whose superior maxilla was being removed, so semi-conscious that after the momentary withdrawal of the chloroform he would, when requested, clear his throat of both blood and mucus. Morphine should be administered with the utmost caution immediately after or as the patient is recovering from the anæsthetic.

#### LOCAL AND REGIONAL ANÆSTHESIA.

The induction of local anæsthesia for the relief of pain was employed long before the discovery of general anæsthesia and its use in

surgery. Like many other methods in medicine and surgery that have for a time been held in abeyance by the discovery of newer and more generally applicable methods, its revival and scientific development have been rapid and its increased value proportionate. This result is in a measure due to the recognition of the intrinsic dangers of general anæsthesia, and that it is not justifiable in many cases to subject the patient to such risks when equally effective and harmless methods will attain the same resulting abolition of sensation.

Besides being of value in cases in which general anæsthesia is contraindicated, these methods can be applied by the surgeon or practitioner in minor cases of surgery without the aid of a professional assistant. It possesses over nitrous oxide the advantages of being more portable and more readily applied without assistance, while the period of anæsthesia is much longer. An accurate knowledge of the neural anatomy of a particular region enables the operator to anæsthetize large areas, and to operate with entire freedom from the annoyances of œdema, that have been pointed out as objections to operations under the infiltration method.

There are, however, valid objections, and the cases in which local anæsthesia is applicable should be selected with care. It does not produce relaxation, nor does it give the surgeon the same control over the patient. These are considerations that must be taken into account, especially in operating on patients of highly nervous temperament. Although the patient is entirely free from pain, the shock to the nervous system may be so great that a general anæsthetic should be used.

With a perfected technique local anæsthesia can be employed with entire satisfaction for certain major operations where the subject is suitable. Thus Cushing has performed numerous difficult operations for hernia with perfect success, and finds it especially valuable in persons suffering from the shock consequent upon strangulation. In these cases the dangers arising from fecal vomiting and inspiration pneumonia are greatly decreased by omitting the general anæsthetic.

In ophthalmic operations and those involving mucous surfaces it can also be used with advantage. Cystoscopic and urethral examinations can be made painlessly by its use, and litholapaxy has been successfully performed under cocaine anæsthesia.

The older methods of freezing have been improved upon and in many cases entirely supplanted by medicinal agents that produce more lasting results with less pain incident to their application and less injury to the tissues.

Modern methods of anæsthesia may be divided into those that produce anæsthesia by the action of drugs upon the nerve-endings or

upon nerve-trunks, and those that depend upon the abstraction of heat or freezing for their action.

#### DRUGS AS LOCAL ANÆSTHETICS.<sup>1</sup>

Solutions of cocaine and eucaine  $\beta$  are the drugs most efficient and reliable in producing anæsthesia. The solutions most generally employed are of 2 to 4 per cent. strength, or even weaker, but with a maximum limit of  $\frac{1}{2}$  to  $\frac{3}{4}$  of a grain at a single sitting. Their efficiency is increased by the addition of 2 per cent. of salt, forming a saline solution whose endosmotic equivalent is nearly equal to that of the body-fluids. They are thus taken up by the tissues without producing an artificial œdema, nor do they extract fluid from the tissues. This renders their introduction less painful.

The relative value of cocaine and eucaine  $\beta$  as anæsthetic agents is nearly equal. Cocaine is slightly more powerful, is more irritating, is followed by more serious sequelæ, and is liable to decompose more readily. Contrary to general opinion, it has been found that cocaine solutions can be sterilized by boiling once or twice without injuring their efficiency, while eucaine can be boiled as often as required. Undoubtedly cocaine is the drug most frequently employed. Eucaine is, however, rapidly coming into favor.

These drugs and their solutions may be applied by instillation, as in the eye, or the urethra and bladder; by means of an atomizer, as in the nose or mouth; by the application on pledgets of cotton; by hypodermic injections; by injecting their solutions locally into areas to be operated on; by the regional method, injecting into the trunks of nerves, thus producing regionary anæsthesia in the entire area of their distribution, or into regions shut off by controlling the circulation with an elastic band, as in the fingers; by infiltration or the introduction into the skin of a large amount of a dilute fluid, as a normal salt solution containing but a small percentage of an active anæsthetic agent, as cocaine.

In employing instillations of cocaine or eucaine in urethral and out bladder examinations or operations, the bladder should be washed with boric-acid solution before the anæsthetic is injected. Two ounces of a 4-per-cent. solution of eucaine or cocaine should be injected into the emptied bladder and allowed to remain four or five minutes; the catheter should be partly withdrawn, permitting some of the fluid to escape into the deep urethra. The anterior urethra is then filled with the same 4-per-cent. solution, which is retained for five minutes.

<sup>1</sup> See article on this subject in Dr. Spencer's article on "Minor Surgery," in this volume.

Instillations in the eye are produced by dropping a few drops of a 4-per-cent. cocaine solution into the eye and repeating it two or three times at intervals of three or four minutes, when anæsthesia will be found complete.

In all operations performed under the influence of cocaine or eucaïne the patient is best in a recumbent position. Vertigo, dilated pupils, cold extremities, palpitation, slow pulse with high tension, dryness of the throat, restlessness and delirium are some of the dangerous symptoms that have followed its use in patients especially susceptible to cocaine. The treatment is that for shock and collapse under any other conditions.

The risk of such dangers can be avoided by employing very dilute solutions by the infiltration method, as worked out by Schleich. The solutions are injected in large quantities. They produce a wheal when injected, the needle is pushed through this to its other edge, another wheal made, and another and another, all in the line of the intended incision. The injection must be in the true skin, and not in the subcutaneous cellular tissue. The incision can then be made without pain, and the infiltration anæsthesia will persist for over half an hour, so that an intercuticular suture can be placed in position without pain if the needle does not pass out of the infiltrated area.

The solutions for infiltration are more effective if they are used at body-temperature. The eucaïne  $\beta$  solution is made of 1 part of eucaïne, 8 parts of common salt, and 100 parts of distilled water. It may, however, be used much weaker, as in the Schleich solutions, which contain in a quart of water 30 grains of cocaine,  $3\frac{3}{4}$  grains of morphine, and 30 grains of common salt, or the cocaine may be reduced to 15 grains. The stronger solution is used in highly inflamed parts, while the second is most generally used.

In all anæsthesias where cocaine or eucaïne is employed it is well to administer, according to the patient's susceptibility,  $\frac{1}{8}$  to  $\frac{1}{4}$  gr. of morphine, with  $\frac{1}{100}$  gr. of atropine, and, if stimulation is indicated,  $\frac{1}{30}$  gr. of strychnine.

#### ANÆSTHESIA FROM COLD.

The old method of employing powdered ice with one-half its bulk of common salt added is modified by placing the whole in a rubber bag. The action of freezing is, however, too extensive, and has given rise to serious sloughing of the tissues.

Ether spray from an atomizer held at a little distance will produce sufficient cold to make the part superficially insensitive.

Rhigoline is another preparation capable of producing intense cold

by its sudden evaporation ; but it is inflammable, and consequently dangerous.

Others that are equally efficient are anæstiles, and other forms of ethyl chloride under various names. Their action, however, is superficial and transient, and they can only be used for superficial incisions.



# SURGICAL TECHNIQUE.

By CHARLES H. FRAZIER M. D.

## ASEPSIS AND ANTISEPSIS.

THE rapid strides made in recent years toward the perfection of operative technique have been a source of the greatest satisfaction and comfort to the surgeon. Hitherto in his prognosis he always had to take into consideration the possibility of infection, and this cloud constantly hovered over his case until union of the wound had occurred. To-day the surgeon is reasonably sure that with the adoption of improved methods in all their details infection of the wound will be exceptional.

It is interesting to recall the steps by which this state of what might almost be called perfection was reached. There were the days of Listerism, when everything was regarded as septic, both air and matter, and strong antiseptic solutions were used in profusion to combat the efforts of infecting organisms, the characteristics of which were then so little known. Soon it was determined by investigation that wounds did not ordinarily become infected through the air as a medium; that infection was the result of contaminated objects coming in contact with the wound. In the preparation of the field of operation, of the instruments, and of all the necessary appurtenances, antiseptics were used almost exclusively, and during the operation all that came in contact with the wound and the wound itself were freely and frequently drenched with strong chemical germicides. Those were the days in which antiseptics had full sway; and while results considered remarkable, as compared with pre-antiseptic days, were obtained, still a sufficiently large number of wounds became infected to stimulate further investigation, and to prove that despite the employment of antiseptic solutions pus-producing organisms gained entrance to wounds and flourished there. The next stage in the development of the present technique is marked by the substitution of chemical sterilization by other and more efficient methods. The subjection of all articles required during the performance of an operation to steam, hot air, or boiling water, guaranteed their absolute sterility; thus the operator could assure himself that, unless the skin of the field of operation or his own hands were contami-

nated with pyogenic organisms, he could dispense with the employment of bactericidal solutions during the actual performance of the operation, and with antiseptic dressings thereafter. For these reasons the so-called antiseptic methods were gradually dispensed with, and asepsis took its place.

Asepsis was a term which, when first adopted, implied the absence of micro-organisms, and at that time the absolute sterility of the wound was believed to be a *sine qua non* of primary union. Aseptic methods were employed only when the operation could be carried out in the absence of micro-organisms, and were not well suited to those operations conducted in the presence of wounds or tissues already contaminated. To-day a different interpretation is put upon the term asepsis, since it has been proved that primary union will occur despite the presence of micro-organisms; that cultures may be made from the wound just before it is closed, and upon the culture-media will be found organisms which at times are pyogenic. Asepsis to-day means, therefore, the absence of organisms which, by their virulence or their numbers, do give rise to sepsis.

Surgeons were not long in ascertaining that factors other than the mere absence or presence of micro-organisms must be taken into consideration before they could hope to combat successfully with this perplexing problem. These factors are more clearly comprehended to-day than ever before, and to their comprehension must be attributed the brilliant results that crown the present stage in the evolution of surgical technique. The virulence of the organism, the vitality of the tissues at the seat of operation, the general condition of the patient, the conditions prevailing in the wound immediately after the operation—these are the questions which command the attention and consideration of all practical surgeons. A clear perception of the relative importance of these questions furnishes the key to the solution of the problem. While the surgeon is to be congratulated upon the attainments of modern surgery, his efforts would have been futile were it not for the information that has been supplied from the laboratory of the bacteriologist. The advances in surgery are so intimately associated with, and so dependent upon, the results of bacteriological investigation that one should be familiar with at least the general characteristics of those organisms that have to be reckoned with.

#### SURGICAL BACTERIOLOGY.

The organisms that are responsible for infection may be either bacteria, fungi, or protozoa; but in the great majority of instances bacteria are the offending agents, and of these, two classes are recognized, the obligate and the facultative. The obligate pyogenic organism is one which is always a pus-producing organism, while the

facultative organism is one which in the course of its growth and activity in living tissue may or may not elaborate pus. Among the former class are to be found the staphylococci, streptococci, *Bacillus coli communis*, gonococcus, *Micrococcus lanceolatus*, *Bacillus pyocyaneus*, and *Micrococcus tetragenus*, while the *Bacillus tetani*, diphtheriae, proteus, typhi abdominalis, tuberculosis, anthracis, and the *Bacillus oedematis maligni* are facultative organisms.

These organisms are differentiated one from the other by their reaction to stains, by the nature of the products they elaborate (that is to say, the color, odor, and consistency of the pus), and by the character of their growth upon different media. The staphylococcus group accounts for probably 80 per cent. of all cases of infection; staphylococci grow upon almost any media, and are both aerobic and anaerobic. They elaborate chemical products which are noted for their peptonizing effect upon the cellular structures.

Next in frequency are the streptococci, which, like the staphylococci, grow on all media at ordinary body-temperature either in the presence or absence of oxygen. This organism, whose virulence is most variable, has often been found to be responsible for that most fatal of wound complications—pyæmia.

The *Bacillus coli communis*, the most ubiquitous of all the pyogenic organisms, is of comparatively little importance except in operations upon the abdominal viscera. While its normal habitat is in the intestinal canal, it has been held accountable for infection of the urinary and gall-bladder, the kidney, and brain, to say nothing of the appendix and peritoneum. Its virulence is most variable; an organism harmless in its normal habitat has been known to give rise to an intoxication proving rapidly fatal.

The *Micrococcus lanceolatus*, the pneumococcus of Fränkel, is an organism found in the mouths of individuals enjoying perfect health. It plays little part in the etiology of wound-infection, although cases have been reported in which it proved to be the infecting agent—a fact which led to the adoption by some surgeons of a mouth-shield which prevented the escape of organisms from the operator's mouth during the course of an operation.

The *Bacillus pyocyaneus* elaborates a pigment which gives to pus a bluish-green color. It is rarely found in pure cultures in wounds, and it usually persists in cases of prolonged suppuration. It is so tenacious and difficult to eradicate from wounds that it is questionable whether it is affected by the chemical antiseptics of the strength commonly used.

The *Micrococcus tetragenus* has been found in tubercular cavities of the lung, and in abscesses about the neck, face, and hands, and gives rise to prolonged suppuration.

The micrococcus of gonorrhœa exhibits a predilection for the mucous membrane of the urethra, vagina, and conjunctiva, and may give rise to metastatic lesions in serous membranes—the pericardium and endocardium, the pleuræ, the peritoneum, and synovial membranes.

The facultative organisms play only exceptionally a part in primary wound-infection; the *Bacillus diphtheriæ* occasionally attacks wound-surfaces, when it may give rise to such constitutional disturbances as attend nasopharyngeal diphtheria.

These then are the organisms which must be dealt with. What are the laws that govern bacterial growth, and what are the circumstances that govern their behavior when they invade the human system? Bacteria belong to the lowest order in the vegetable kingdom, and are dependent for their existence upon the presence of living or dead organic material; they cannot assimilate inorganic matter. The rapidity with which they multiply is astounding; in the course of two days one bacterium may produce 281,500,000. They multiply either by direct cell-division or by spore-formation. This fact has an important bearing upon the question of sterilization: to insure sterilization of material contaminated with organisms which multiply by spore-formation, this material must be subjected to two or three successive sterilizations, inasmuch as the spores themselves are enveloped in a dense membrane and resist the usual methods of sterilization. Almost all bacteria are capable of motion independent of that attending the process of chemotaxis; the majority are aërobic, grow best in an alkaline medium (such as blood-serum), and at a temperature of 30°–40° C.

In studying the methods by which bacteria attack the tissues of man, a bacterium must be looked upon as a living cell dependent for its existence upon the presence of living or dead organic matter. These cells are able to digest animal tissues, and during the course of this process certain waste-products are elaborated, precisely as in the process of metabolism in healthy tissues certain waste-products are elaborated. In the latter instance these waste-products are alkaloidal substances, such as urea, and carbon dioxide, elaborated by complicated chemical processes at the expense of proteid material. In the former instance the waste-products are also alkaloidal substances, to which the terms *leucomaines* and *ptomaines* have been applied.

The importance of understanding the conditions which favor or predispose to infection has been alluded to. These conditions have to do with the virulence and character of the organism itself, with the nature of the soil in which it is lodged, and with the manner in which the individual reacts to micro-organismal invasion.

That there is a wide variation between the virulence not only of



organisms of the different groups, but also of those of the same group, has been frequently demonstrated. Infections due to a pure culture differ from those due to a mixed culture. Just how one variety of bacteria exerts any influence over another is not understood, although clinically and experimentally this phenomenon has been repeatedly demonstrated. In some instances the presence of certain bacteria may altogether inhibit the growth of others, and conversely the virulence of one micro-organism may by the presence of another be materially exalted. Bacteria usually lose their virulence after a series of successive inoculations. Light has in all probability as much influence over the growth of bacteria as any other factor; sunlight is their bitterest enemy—dark, ill-lighted, and ill-ventilated places are conditions most favorable to their growth. The passage of bacteria through certain animals influences the virulence of bacteria—*e. g.*, the bacilli of swine septicæmia are influenced by passing through pigeons, while the virulence of the tubercle bacillus is increased by its passage through certain animals.

Infection is further affected by what might be called local predisposition: that is to say, there are certain conditions of the tissues which seem to predispose to infection, and it is these conditions that have been most carefully studied in connection with the subject of the treatment of wounds. Certain disturbances of the vascularity of the part, which in rare instances consist in a hyperæmia, but in the great majority of cases a local anaemia or ischæmia, determine infection by depriving the part of those elements with which bacterial invasion is largely combated. The blood is known to have qualities distinctly bactericidal, not only through the agency of the leucocytes in the rôle of a phagocyte, but also through the agency of the fluids which the leucocytes generate. It is for this reason that cicatricial and adipose tissues have less resistance than the vascular structures of the scalp. Trophic disturbances, interference with the nerve-supply of a part, these have long been recognized as predisposing to infection. Disturbances, therefore, of the vascular or nervous supply from whatever cause, whether it be trauma or disease, so lower the vitality of the tissues as to rob them of their ability to react to the invasion of the organism. Extravasation of blood, injury to the nerves, contusions, degenerations, or necrosis of the tissues, may all follow traumatism, and all alike predispose to infection. Interference with the drainage of a wound or with the evacuation of the contents of the hollow viscera, as the urinary or gall-bladder, seems either to increase the virulence of the organism or to reduce tissue-vitality. Local predisposition is, then, of the utmost significance in the treatment of wounds. It involves the question of hæmostasis, of drainage, of the selection of ligature-

material, of the use of antiseptic solutions, and of the methods of closure of the wound. These subjects will be taken up later under appropriate headings.

Finally, there remain to be considered those characteristics of the individual which undoubtedly influence his power to resist infection. There is no question that certain individuals are more susceptible to infection than others; two patients, both apparently enjoying good health, are subjected to the same operation, with the same precautions, and under similar conditions: in one case infection follows; in the other the wound heals by first intention. When patients who show this susceptibility are exposed to infection, not only do they acquire it more frequently, but the character of the infection is also correspondingly more severe. Unfortunately, the human race as a whole, compared with the lower animals, are particularly susceptible to the action of pyogenic organisms.

Immunity against infection may be natural or acquired. The immunity which the negro enjoys against yellow fever, or the Japanese against scarlatina, is an example of natural immunity; but this form of immunity has no practical bearing upon wound infection. The most commonplace example of acquired immunity is that enjoyed by those who have been inoculated with the antitoxin of diphtheria. Serum-therapy of to-day is the natural outcome of the recognition of the existence of the phenomenon of immunity.

There are certain conditions of the tissues at certain ages that affect infection; the child is more susceptible to the eruptive forms than the adult; while the adult is more susceptible to the so-called pyogenic organisms than the child. The germs of tuberculosis find the most favorable field in the glands in infancy, in the bones and joints in childhood and adolescence, and in the lungs in adult age.

Bad environment, overcrowding, confinement, and bad sanitary conditions in general are all predisposing causes of infection. So, too, are the simple and pathologic anæmias, as well as all chronic infections and visceral diseases, such as syphilis, scurvy, rickets, diabetes mellitus, alcoholism, cardiac and renal disease, and amyloid degeneration of the viscera.

#### SOURCES OF INFECTION.

Unless familiar with the sources of infection, it would be manifestly impossible with any measure of success, to protect the tissues against bacterial invasion. The pyogenic and non-pyogenic bacteria are not, as has been supposed, to be found only in tissues in which they are actively engaged in producing their characteristic lesions. They are found in the mucous and cutaneous surfaces of individuals in perfect health as well as in disease; they are found in the particles

of dust circulating in the water and air, as well as in the soil under foot. They are abundant in the air of densely populated cities, and still more abundant in the air of hospital wards. The air at sea and on mountain-tops is, on the other hand, comparatively free.

In a general way, it may be said that there are two sources of infection—the external and the internal.

The external sources of infection include those objects which at one time or another come in contact with the wound; in operative wounds these may be ligatures, sutures, sponges, instruments, dressings, and the hands of the operator, assistant, or nurse; in accidental wounds there may be, in addition, the clothes of the patient, particles of dirt, machinery, or any object which may have inflicted the wound. At one time considerable importance was attached to the air as a source of infection during operations; while pyogenic organisms are taken up by particles of dust, they do not lodge in the wound in sufficient quantities during the course of an operation to give rise to infection. Fortunately, organisms do not multiply in the air; and still more fortunately, most of them lose their virulence in the course of time and eventually become inert.

In regard to the internal sources of infection, they include the skin and mucous membrane, for not only are organisms found upon the mucous and cutaneous surfaces, but at times in the deep layers of these structures and in the ducts and follicles of the mucous or subcutaneous glands. In almost every instance, however, their virulence is so slight that were a wound inflicted in their presence no ill effects would follow. Just why their virulence is so depressed is not altogether understood, but it is more than likely due to the bactericidal action of the body-fluids together with the antagonistic effect of one organism upon another. It must be borne in mind that the cells of structures deeper than skin or mucous membrane are the habitat of organisms during health. The presence of these inactive or quiescent organisms in the tissues has been spoken of as "latent microbism." The air we inspire, the food we eat, are laden with organisms, which are distributed along the digestive and respiratory tracts; at the entrance to these tracts the organisms are found in greatest abundance.

In enumerating the sources of internal infection, the possibility of a wound becoming infected through the circulation suggests itself. While there is no reason for positively denying the possibility of such a mode of infection, yet no experiments or observations have been made in proof of it; and yet cases do occur in which there seems to be no other explanation, no other way to account for this complication. Secondary infection is but an example of the way in which infection may be disseminated through the channels of the circulation,



and as such may be advanced as an argument in favor of secondary, or even primary, wound infection through the same channels. Numerous examples of so-called secondary infection could be cited; thus, acute osteomyelitis secondary to pneumonia, acute cholecystitis secondary to typhoid fever, hepatic abscess secondary to amœbic dysentery, infectious nephritis secondary to scarlatina. If these structures can be infected through the medium of the circulation, it is, to say the least, within the bounds of possibility that wounds may be infected in a similar way.

#### METHODS OF STERILIZATION.

It is all-important to be conversant with the various methods of sterilization, since various articles and materials require different methods. Thus, what is suitable for metallic instruments is not suitable for rubber catheters, and what is a suitable method of sterilizing ligatures and sutures is not applicable to the preparation of the operator's hands or the patient's skin. In general, it may be said that we give preference to that method which is, first of all, most efficient, which requires the least time, which is least injurious to the article to be sterilized, which is least expensive, and which, finally, is the least complicated. The various methods of sterilization may be classified as follows:

I. Thermal, or those dependent upon the action of either moist heat (steam or boiling water) or dry heat (hot air or the actual flame).

III. Chemical, or those dependent upon the action of chemicals; these may be subdivided again into (1) those which are strictly germicidal and those which only inhibit the growth of organisms, and (2) those which are used in solution and those as gases (formaldehyde).

III. Mechanical sterilization.

I. **Thermal Sterilization.**—Of all the methods at our command, none is more efficient and none has done more toward simplifying the work of preparing for an operation. All things being considered, boiling water is the most rapid and still the most reliable form of heat sterilization; the most resistant spores succumb when subjected to water at a temperature of 212° F. for two minutes.

In addition to being the most efficient method of sterilization, it is also the simplest; it can be carried out in the most modest dwelling-houses as well as in the hospital, and requires no expensive or specially constructed apparatus. It should be used universally for the sterilization of instruments, for there is no other method which will prove less injurious. Instruments may be rendered perfectly sterile by boiling for fifteen minutes, and, if a small quantity of carbonate of sodium, or ordinary washing soda, be added to the water, it will prevent rusting. Schimmelbusch pointed out that the addition

of soda renders the water slightly antiseptic. All articles of agate or glass can be subjected to sterilization by boiling water, and ligatures and sutures are often sterilized by boiling in alcohol (see p. 00).

Next in order of efficiency is sterilization by steam. Experiments go to prove that anthrax-spores, which are the most resistant of either the spore or adult form of all pyogenic micro-organisms, and therefore the best suited for experiments of this nature, are destroyed by exposure for fifteen minutes to steam under fifteen pounds pressure. The steam sterilizing apparatuses on the market are both portable and stationary. The familiar sterilizer of Arnold and that of Lau-

FIG. 18.



Lautenschläger's combined instrument- and dressing-sterilizer.

tenschläger are equally efficient and serviceable for office-work or operations in private rooms. The apparatus of Lautenschläger is very conveniently arranged, compact, and combines both an instrument- and a dressing-sterilizer (Figs. 18 and 19). The instruments and dressings may be sterilized separately or simultaneously. An attractive feature of this sterilizer is the arrangement for transporting the dressings after they have been sterilized. Fig. 19 shows two receptacles in which, after sterilization, the dressings can be transported without exposure.

For hospital purposes a larger sterilizer is necessary (Figs. 20 and 21). These are stationary apparatuses, and are constructed for either

steam or gas heat ; they differ from the portable sterilizers in that the articles are subjected to steam under high pressure. They are so constructed that the dressings can be dried in the autoclave after they have been sterilized by simply turning off the steam from the internal chamber and allowing it to circulate only in the outer chamber. They are supplied with a steam gauge (showing both temperature and pressure), water-gauge glass, safety-valves, steam regulating and vacuum valves, and automatic gas-regulator.

A great majority of the articles required for dressings or operations may be sterilized by this method ; the pitchers, basins, trays, the

FIG. 19.



Lautenschläger's combined instrument- and dressing-sterilizer, showing cage for instruments, cage for the dressings, and two boxes for dressings, one with shutters open ready for sterilization, the other with shutters closed ready for transportation.

dressings, pads, towels and sheets, some of the sutures and ligatures, and the operator's gloves.

In order to insure perfect sterilization of towels, sheets, dressings, and pads they should be subjected to an exposure to steam, at a temperature of  $115^{\circ}$  C., under a pressure of fifteen pounds. This is particularly adapted to the sterilization of packages of such materials as gauze or towels, since it is necessary that the steam be under pressure to insure its penetration to every point in the package. For the sterilization of porcelain, agate, or glass-ware, such as pitchers, basins, trays, and receptacles of various kinds, a sterilizer constructed on very much the same plan as the instrument-sterilizer, only on a larger scale, will prove most convenient.



From what has been said, it will be seen that, with the exception of the operator's hands and the skin of the patient, everything which may come in contact with the wound can be rendered sterile by the thermal method.

Superheated air is another form of applying thermal sterilization ; but it is not to be preferred to heat, because it requires a longer period of time and a higher temperature to accomplish the same end ; whereas the spores of anthrax are destroyed by steam at a tempera-

FIG. 20.



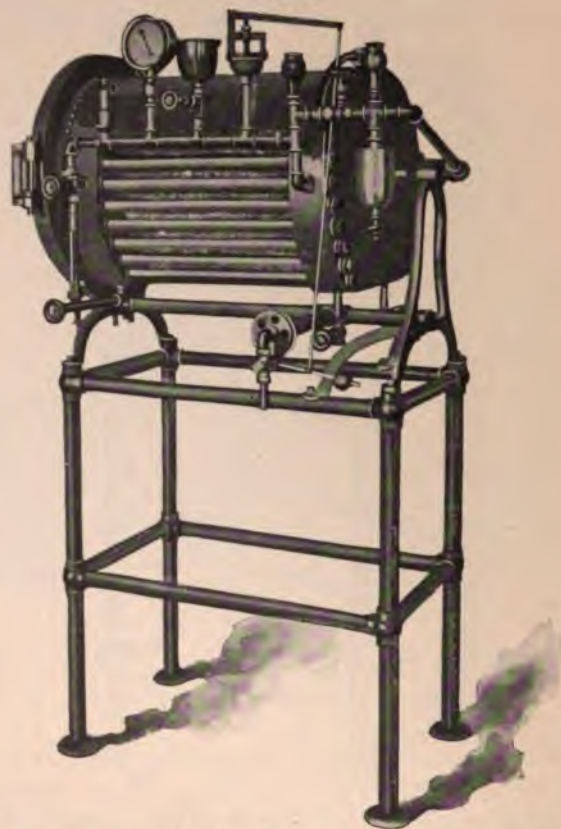
Steam dressing-sterilizer.

ture of  $105^{\circ}$  C. in fifteen minutes, the same spores will be destroyed by air at a temperature of  $140^{\circ}$  C., and then only after an exposure of at least three hours. On account of the longer exposure and higher temperature requisite for sterilization by hot air this method is not used. The actual flame is sometimes used in cases of emergency to sterilize instruments. The instrument is immersed in a small quantity of alcohol and the latter ignited. This method is not to be endorsed for routine practice because of its injurious effect not only

upon the nickel or silver plating of instruments, but also upon the edge of cutting instruments.

**Chemical Sterilization.**—A number of drugs have at one time or another been called into play for this purpose, some having a germicidal effect, others only inhibiting the growth and activity of organisms. This method of sterilization was at one time used almost exclusively, not because it was the most desirable, but because better

FIG. 21.



Showing steam-generating tubes surrounding the internal copper cylinder.

methods were not known. There are many objections to chemical sterilization, chief among which are the length of time required and the injury inflicted upon objects with which the chemical comes in contact. An instrument can be sterilized by boiling in ten minutes; it cannot be sterilized by chemical disinfectants in less than an hour. In order to be bactericidal in their action, solutions have to be employed of such strength as to have a distinctly deleterious effect upon



objects with which they come in contact; they are damaging alike to instruments, to the hands, and to the tissues of the wound.

As pointed out above, the hands of the operator and the tissues of the patient are about the only objects which cannot be subjected to steam sterilization. As a last resort, therefore, the surgeon turns to chemical sterilization, a method in which his faith has been so often shaken and his confidence so misplaced. In order to estimate properly the value of a chemical disinfectant one must take into consideration the concentration of the solution, the time required for its action—*i. e.*, whether germ-inhibiting or germicidal—its effect upon living tissue, and the modification of its action in the presence of living tissue. The germicidal or germ-inhibiting effect of the individual chemical disinfectant is usually based upon laboratory investigations, the results of which are of questionable value, in that they are not conducted under conditions that exist in wounds. Thus we are told that if an organism be subjected to the action of a certain drug at a given strength and a given time, that this organism will either be destroyed or rendered inert. When we come to apply the results of these investigations to practice we find that a solution of that strength will so lower the vitality of the tissue as to diminish its power of resistance; that under favorable circumstances the organisms, whose growth was for the time inhibited, may become resuscitated, as it were; that in the presence of the wound-secretions the drug may be decomposed and rendered inert; that when applied to an extensive wound enough of the drug may be absorbed to give rise to intoxication; that it is often impracticable to expose the wound to the effects of the solution for a period of time sufficient to insure sterilization. All these questions must be constantly borne in mind when applying the results of laboratory investigations to actual practice.

The ideal chemical disinfectant is yet to be discovered. Such a one must be freely soluble in water, non-toxic in the concentration in which it is employed, non-decomposable when coming in contact with the body-fluids or on standing; it should not lower the vitality of tissues, and should be non-irritating; it should be absolutely germicidal in a reasonably short time, inexpensive, and of an agreeable odor.

While many drugs have at one time or another been used as chemical disinfectants, but few have sufficient individual merit to warrant their recommendation. The following are of unquestionable value: bichloride of mercury, carbolic acid, permanganate of potassium, iodoform, formalin, peroxide of hydrogen, and the silver salts.

BICHLORIDE OF MERCURY is the most reliable and therefore the most popular of all chemical disinfectants. It occurs as a white, odorless, crystalline powder, soluble in water (1 : 16), alcohol (1 : 3), and ether. A solution of 1 : 1000 may be made by adding  $7\frac{1}{2}$  grains



of the salt to a pint of water. In hospital practice a saturated solution may be kept on hand, in which one fluidrachm containing  $7\frac{1}{2}$  grains added to a pint of water makes a solution of 1 : 1000. The saturated solution should be made up with hot distilled water, as with ordinary water the earthy substances combine with the mercury and form an inert salt ; and the solution should be kept in blue glass bottles, as it decomposes upon exposure to the light.

Jars, pitchers, basins, and trays, and rubber goods (including gloves, drainage-tubes, mackintoshes, tourniquets) may be sterilized by immersion in a 1 : 1000 solution for several hours, or in a 1 : 500 solution for a shorter time. Drainage-tubes, sponges, and swab-sticks may after sterilization be kept in jars containing a 1 : 1000 aqueous solution. Catgut and silk ligatures and silkworm-gut may after sterilization be kept in a 1 : 1000 alcoholic solution. This in time makes ligatures and sutures so brittle as to render them unfit for use. In the preparation of the hands the latter are immersed in a 1 : 1000 aqueous solution, and in the preparation of the skin at the field of operation a douche of 1 : 1000 may be employed. For the disinfection of wounds already septic a solution of 1 : 5000 may be used to advantage ; its irritant effect upon the tissues has led to its discontinuance in the treatment of non-infected wounds. It has been claimed by Kowalewsky that bichloride of mercury has a distinct chemotactic action upon the tissues which enhances to a great degree its value as a germicide.

*Ill-effects.*—Mercuric chloride acts as an irritant to the skin when exposures are too frequent or of too long duration, or when strong solutions are employed. Thus the fingers and hands of the operator may become so fissured and cracked that their sterilization becomes impossible ; the application of a wet bichloride dressing to a sensitive skin for several hours may excite a dermatitis, in the presence of which it is unwise to operate. Absorption may take place through wound surfaces sufficient to give rise to marked toxic symptoms. Attention should be called to the fact that some individuals exhibit a peculiar idiosyncrasy to the action of this salt.

Metallic instruments should never be immersed in a bichloride solution. The latter erodes the metal or the plating, and takes the edge off all cutting instruments.

CARBOLIC ACID, next in order of efficiency to bichloride of mercury, is a product of the destructive distillation of coal. It is soluble in water (1 : 20), glycerin, and alcohol. It is freely miscible with oily substances and with wound-secretions.

*Usage.*—Carbolic acid is used chiefly as a substitute for bichloride of mercury ; but it is in no way superior, and is in many respects inferior, as a chemical disinfectant. The indications for its use correspond to

those enumerated for bichloride of mercury, viz., the sterilization of articles which cannot be subjected to the thermal method. In order to insure sterilization these articles must be immersed in a 1 : 20 solution for from one to two hours. In some instances it is used in combination with the mercuric salt for the disinfection of the hands and field of operation; but inasmuch as it is an irritant to the tissues it is by no means an ideal disinfectant.

During the performance of an operation the instruments may be kept immersed in a 1 : 40 to 1 : 20 solution of carbolic acid without very deleterious effect. In this particular alone it possesses superiority over bichloride of mercury. Carbolic acid is very volatile, and when applied as a wet dressing the latter must be frequently changed in order to insure a continuous effect. As a matter of historic interest, it may be mentioned that it was Lister's original disinfectant.

*Ill-effects.*—When employed as a disinfectant for the hands the skin may become irritated, rough, and cracked, and, if subjected to prolonged or repeated immersions, the fingers and hands of the operator become benumbed. The irritant effect is also manifest in the disinfection of wound surfaces, in which it excites an exudation of serum. Applied in the form of a wet dressing its action has caused necrosis of tissue—carbolic acid gangrene—which in some cases has involved the entire thickness of a finger or toe. Forty-eight cases of carbolic acid gangrene have been recorded, in some of which only a 1 to 2 per cent. solution was used. The affected finger or toe first turns a whitish-yellow color; later becoming brown or black, stiff, cold, and lacking sensation. The gangrene is due, in all probability, to a subcutaneous œdema. Apart from these local manifestations, sufficient may be absorbed through the wound surface, especially if the wound be extensive, to give rise to the constitutional symptoms of carbolic acid poisoning. The first indication may be its appearance in the urine, which becomes smoky and of a dark olive-green color, a condition which demands the immediate discontinuance of the disinfectant. The urinary symptoms may be entirely absent, however, and they seem to bear no distinct relation to the degree of intoxication. The other symptoms are either gastro-intestinal (nausea and vomiting), cerebral (vertigo, tinnitus aurium, and stupor), or those of collapse, terminating in death, which results from respiratory failure.

SALICYLIC ACID, CREOLIN, and LYSOL are, like carbolic acid, coal-tar products, and may be used as substitutes therefor, although to no advantage. A solution of salicyelic acid in connection with boric acid (Thiersch's solution), though at one time quite generally employed, is now seldom used.

**PERMANGANATE OF POTASSIUM** is used solely in connection with oxalic acid in the disinfection of the skin. It is bactericidal in the proportion of 1 to 833 parts.

**BORIC ACID**, in the form of a saturated solution (gr. xv- $\bar{3}$ j), is used chiefly to irrigate mucous membranes, especially those of the bladder, eye, and mouth. It, however, has no bactericidal properties, and probably has little if any inhibiting effect upon pyogenic organisms. It is, therefore, simply a bland, non-irritating fluid, and as such may be used with satisfaction. In the treatment of wounds proper, excepting those of mucous membranes, it has no place.

**IODOFORM**,  $C_2HI_3$ , is a yellow, crystalline substance, containing 96 per cent. of iodine; it is soluble in ether, alcohol, and chloroform, but insoluble in water. Iodoform has no bactericidal property itself, but exerts an inhibiting effect upon the action of microorganisms by neutralizing their toxins, the leucomaïns or ptomaïns. Between these and iodoform a chemical reaction takes place, resulting in the decomposition of iodoform and the liberation of iodine, in the presence of which microorganisms cannot flourish. Inasmuch as iodoform is not of itself bactericidal, and may at the time of its introduction into wounds contain pyogenic organisms, it should always be previously sterilized, either by immersion in a 1 : 1000 solution of bichloride of mercury or by heat. The former method is preferable, since when exposed to heat a certain amount of iodine is liberated and its efficiency thereby reduced.

Iodoform is used as a powder, as an emulsion, and in the preparation of iodoform gauze. The indications for its use are daily growing less, owing to other and more efficacious methods of preventing sepsis. In fact, it has almost come to be discarded in the aseptic treatment of wounds, and its use is relegated to wounds or lesions already infected. In the form of powder it may be dusted into abscess-cavities of the soft tissues or bone, in which it is supposed to neutralize purulent discharge and prevent extension of the infected area. It has a slightly stimulating effect upon granulation-tissue. In the treatment of compound fractures Treves recommends that the powder be dusted freely on the external wound, with the hope of hermetically sealing the wound with an "antiseptic scab" composed of a mixture of iodoform and the dried wound-secretions. In those cases in which there is reason to believe that the wound is not already infected, and that the fragments can be reduced by manipulation, this method is to be recommended as a safe and rational procedure.

In the form of an emulsion, either with glycerin or boroglyceride (10-20 per cent.), iodoform has been employed in the treatment of



tuberculous lesions, especially those of the joints. The solution should always be sterilized before using.

Like iodoform powder, the indications for the use of iodoform gauze are restricted to wounds already infected or in danger of subsequent contamination. Thus in the treatment of wounds, whether operative or accidental, in the neighborhood of the mouth or rectum or anus, where under normal conditions microorganisms abound, it is good practice to protect the wound with iodoform gauze.

*Ill-effects.*—Iodoform may give rise to both local and constitutional disturbances. When applied to the cutaneous surfaces it sometimes excites a dermatitis which may extend some distance from the margin of the wounds, and causes oftentimes such intense itching that patients cannot be restrained from removing the dressing in order to scratch the affected area. When applied to wound surfaces a sufficient quantity may be absorbed to cause iodoform-poisoning. Nausea, intense headache, and varying degrees of delirium are the most constant symptoms. At times its presence may be detected in the urine by the addition of a small quantity of nitric acid and chloroform. If iodoform be present, free iodine will be liberated, giving to the mixture a purplish color. The symptoms of iodoform-poisoning vary widely, according to the quantity absorbed and to the susceptibility of the patient. The cerebral symptoms are the most constant, perhaps, and resemble somewhat those of a meningitis, persistent headache, and delirium, which may be very mild or of the maniacal type. In some cases there are gastro-intestinal disturbances, such as loss of appetite and nausea, pyrexia or hyperpyrexia, with or without acceleration of the heart action, and finally symptoms indicative of collapse. There is no antidote for iodoform-poisoning, the treatment of which must be purely symptomatic, including, of course, the immediate disuse of the drug.

Owing to the peculiar odor of iodoform, so obnoxious to most people, efforts on the part of manufacturing chemists have been directed toward placing on the market an odorless preparation. In general it may be said that these preparations, of which iodol and nosophen are examples, have not as yet taken the place of iodoform in practice.

FORMALIN is a 40 per cent. aqueous solution of formaldehyde gas. Its bactericidal strength places it foremost among chemical disinfectants. A 1 per cent. solution is distinctly bactericidal, and a 1 : 10,000 solution is said to have an inhibitive effect upon pyogenic organisms. Its irritant action, however, practically excludes its use as a disinfectant of the skin or surface of a wound, so that its employment has been restricted chiefly to the sterilization of inanimate objects. It has been used in the preparation of catgut, not only for the pur-

pose of preventing its early absorption, but also as a disinfectant (see *Methods of Catgut Sterilization*). It has further been recommended in the treatment of tuberculous lesions as a substitute for or in conjunction with iodoform. In inoperable neoplasms with offensive ulcerated surfaces it may be used as a deodorant.

Formaldehyde gas is the most efficacious preparation for the disinfection of rooms or buildings in which contagious or infectious cases have been harbored. Its ability to penetrate into the interior of infected articles, bundles of clothing, mattresses, books, etc., is one of its strongest recommendations. Like formalin, its action upon pyogenic organisms is germicidal. It may be employed with advantage in the sterilization of such objects as cannot be subjected to heat. It is particularly adapted to the sterilization of urethral instruments, catheters, bougies, cystoscopes, and urethroscopes; all impurities should be thoroughly removed beforehand, and the instruments then placed in appropriate receptacles, on the bottom of which trioxymethylene powder is then sprinkled, and the instruments exposed to the vapor for a period of from twenty-four to seventy-two hours, according to the complexity of their construction. Each well-equipped hospital should have at least one formaldehyde-gas generator with which to disinfect those rooms in which septic cases have been treated. This applies to both the medical and the surgical apartments. From a series of experiments conducted in the University of Pennsylvania Hospital in 1899 it was found that after rooms had been subjected to an exposure of twenty-four hours, cultures taken from places which before disinfection revealed the presence of pyogenic organisms were absolutely negative. To test further the efficiency of this mode of disinfection, cultures of the most resistant organisms were distributed in packages around the room before introducing formaldehyde gas. Cultures taken immediately afterward were in every case negative.

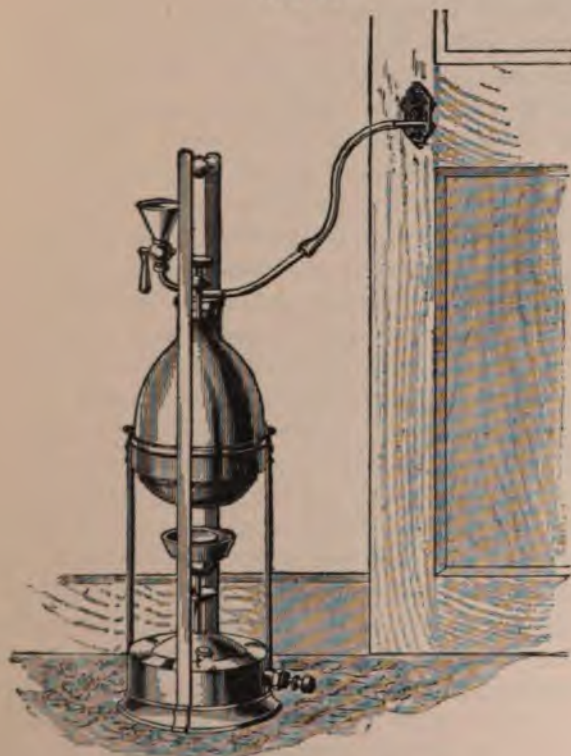
The formaldehyde-gas generator manufactured by Charles Lentz & Sons, Philadelphia (Fig. 22), consists of a stout copper retort of four pints capacity, with funnel filling-tube and indicator, with stopper of special construction and inclined brass outlet-tube of large bore, communicating by means of special flexible tubing with another smaller brass tube, which is inserted through the keyhole of the room to be disinfected.

The directions for using the apparatus are as follows: close all windows, doors, radiators, and chimneys, and small cracks (adhesive plaster is convenient for this purpose). The bed-linen and all articles of clothing should be spread out and not thrown in a heap, in order to expose as much surface as possible to the action of the gas. The furniture and hangings or clothing will not be injured by the gas, and need not therefore be removed from the room. The solution,



composed of 40 per cent. formaldehyde plus 10 per cent. of glycerin, is placed in the copper reservoir and the lamp lit. For practical purposes twelve ounces of solution will be required for every one thousand cubic feet. The local indicator records the amount of solution left in the retort. Removing the cap to fill the reservoir extinguishes the flame instantly, thus rendering it safe to the hands of inexperienced operators. After sufficient gas has been generated the lamp is extin-

FIG. 22.



Lentz formaldehyde-gas generator.

guished and the room kept closed for twenty-four hours, at the end of which time it may safely be regarded as perfectly disinfected.

PEROXIDE OF HYDROGEN is almost universally employed in the treatment of suppurating wounds. From the status of our present knowledge of the drug it would be safe to say that its efficiency is dependent not altogether upon its bactericidal action, but upon the manner in which it invades every nook and corner of the infected wound. When brought in contact with pus ebullition takes place, and continues as the drug is added until all the pus has been oxidized.

The use of peroxide of hydrogen should be confined to suppurating wounds ; it has no place in the aseptic treatment of wounds.

The PERSULPHATE OF POTASSIUM has been recommended as a possible substitute for hydrogen peroxide. As it does not give up its oxygen so rapidly as the peroxide, it has been suggested that it be used in the form of a wet dressing upon suppurating wounds, where its deoxidizing effect would be more continuous.

SILVER.—In recent years attempts have been made to give to pure metallic silver and some of its salts a conspicuous place among chemical antiseptics. Credé, of Dresden, was the first to give these salts a fair trial, and to determine by a series of bacteriological and chemical experiments their true worth. When introduced into a clean wound metallic silver undergoes no change, but in the presence of bacterial secretions a chemical reaction takes place between the lactic acid and silver, forming lactate of silver. The preparations used include pure metallic silver, the lactate and the citrate of silver, and a solution of metallic silver. Pure metallic silver in the form of silver foil has been used for some time as an antiseptic wound protective. The lactate of silver is a white, odorless, almost tasteless powder, soluble in fifteen parts of water, is non-irritating, and in the strength of 1 : 1000 kills pyogenic microorganisms. It may be used in the preparation of catgut or silk ligatures and sutures, as a dusting-powder, and in solutions as an irrigating fluid. Citrate of silver, a light, odorless powder, is soluble in thirty-eight hundred parts of water, and in the strength of 1 : 4000 kills pyogenic organisms. It may be used for the same purpose as the lactate. A solution of metallic silver has been employed in the preparation of silver gauze. In the Carola Hospital, where Credé made his first observations, silver has been used almost to the exclusion of all other antiseptics. In the preparation of gauze, ligature-, and suture-material, as a dusting-powder, and as an irrigating fluid it has given very satisfactory results.

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### PREPARATION FOR AN OPERATION.

This includes the preparation of the operator, the patient, the ligatures and sutures, instruments and dressings, and accessory articles. These will be discussed separately.

The operator must himself scrupulously observe every detail prescribed by the technique under which his clinic is conducted. He must be ever conscious of the fact that he will be looked up to by his staff of assistants and nurses as the example which they are to follow. He must pay the strictest attention to personal hygiene ; his hair should be short and as free as possible from dandruff ; his face

should be clean shaven, or, if he insists on wearing a beard, this should be kept short. The chin of the operator comes in such close proximity to the wound that there is great danger of scales of epidermis falling from the beard into the wound. In preparing for an operation he should remove the outer clothes and don a suit which has been thoroughly sterilized. This suit, composed of shirt with sleeves reaching only to the elbow, and trousers, must be made of some washable material, as duck. A pair of canvas or rubber shoes may be worn at his own convenience; they are not essential, but prevent his every-day shoes being damaged by the chemical solution or soiled by the wound-discharges. In order to guard against dandruff falling into the wound, the hair should be dampened and a piece of sterilized gauze wrapped around his head very much as a turban. This is to be preferred to the ordinary operating-cap, which fits rather loosely on the head, and will not in warm weather prevent perspiration dropping into the wound (see Fig. 13). After the preparation of his hands the operator may put on over his shirt a short, sterile apron—a precaution to guard against the possible contamination of the wound by the suit which he had handled before sterilizing his hands. So far the steps are simple and at the same time satisfactory. There remains to be considered a step in the technique which, more than all others, has commanded the attention of all careful surgeons—the preparation of the hands. Knowing that every other article that is brought in contact with the wound can be subjected to thermal sterilization, the surgeon acknowledges that his own hands or the patient's skin must be held responsible for by far the majority of the cases of infection. It is of paramount importance, therefore, that the greatest attention be paid to this step in the technique. Thermal sterilization not being available, a method must be selected which relies upon mechanical or chemical disinfection, or both. After repeated experiments in the clinic and laboratories, and after repeated discussions, it is the consensus of opinion to-day: (1) that none of the methods in common use can be absolutely depended upon; (2) that more reliance is to be placed upon mechanical than upon chemical disinfection; (3) that no matter what the chemical used, it cannot of itself render the skin sterile; (4) that whereas the surface of the skin may be sterile at the outset, it does not always remain so during the entire operation; (5) that the organisms situated in the deeper layers of the skin, in the subungual region, and in the ducts of the sebaceous glands, are often not reached by the usual methods of preparation, but through friction and after sweating may in the course of the operation find their way to the surface. No matter what the subsequent steps of the process, the preliminary step—the mechanical cleansing with nail-brush and hot

water—must be carried out thoroughly and systematically. The nails having been pared, the surgeon scrubs the hands and forearm as far as the elbow with a sterilized nail-brush for at least five minutes in a sterile basin, using as many changes of sterile water, paying particular attention to the region of the nails. In cleansing the hands attention should be paid to the following points: the finger-nails should be cleaned after the dirt has been softened and partially removed by scrubbing; the nail-brush should not be too hard, and should be sterilized preferably by heat; the water should be as hot as can be borne, as this materially aids in the removal of dead epithelium, fat, and débris. The water should be frequently changed—at least three times—or running water may be used. The time to be occupied in scrubbing should not be less than five minutes, and not more than ten, the choice being left to the discretion of the operator.

**Mechanical Method.**—The mechanical cleansing of the skin is recognized as essential to the perfect disinfection of the operator's hands and the field of operation. By thoroughly scrubbing the skin with soap and hot water not only are loose scales of epithelium and sebaceous matter removed, but also masses of bacteria. This of itself will do more toward rendering the cutaneous surface sterile than immersion of the part in antiseptic solutions. The mechanical cleansing of the skin may be said to have a threefold purpose: first, it removes vast numbers of bacteria; secondly, by removing the oily substances it renders the subsequent chemical disinfection more efficacious; and thirdly, it minimizes the danger of infection of the wound during the course of the operation. For these reasons too much stress cannot be laid upon the importance of carrying out with great thoroughness this step in the methods, hereafter described, for the disinfection of the skin.

**FURBINGER'S METHOD.**—(1) Remove all dirt under and around the nails. (2) Brush the hands and forearms thoroughly with soft soap and hot water. (3) Immerse in 95 per cent. alcohol for not less than a minute, and before this evaporates (4) plunge the hands and arms in a 1 : 500 corrosive sublimate or a 3 per cent. carbolic acid solution, and thoroughly wash them for at least a minute, after which the hands may be rinsed in warm water and dried.

**WELCH'S METHOD.**—(1) The hands and nails are to be thoroughly cleansed with hot water and soap. The water is to be as hot as can be borne, and the brush must have been previously sterilized with steam. This preliminary brushing occupies from three to five minutes. (2) The hands are then rinsed in clear warm water. (3) They are then immersed for one or two minutes in a warm saturated solution of permanganate of potassium; while in this solution



WEIR AND STIMSON'S METHOD.—(1) Scrub the hands and forearms with a brush and green soap in running hot water. (2) Place out a tablespoonful of lime in the palm of the hand, and place on the lime an equal amount of sodium carbonate, and to this add sufficient water to make a thick paste. The latter is rubbed over the hands and forearms so that it comes in contact with the entire surface, and is introduced around and beneath the nails by means of a bit of sterile orange-wood. From three to five minutes should be consumed in this step. (4) Rinse the hands and arms in hot sterile water. In order to remove the odor of chlorine gas, which is liberated in the reaction between the lime and soda, the hands may be immersed in a 0.2 per cent. solution of aqua ammonia.

These three methods, or slight modifications of them, are the most popular and at the same time most efficacious. For each one certain advantages are claimed and certain objections advanced. Those advocating the potassium permanganate and oxalic acid method claim that it is less irritating to the skin than that which requires the use of corrosive sublimate or carbolic acid. The chlorinated lime and soda process is said to remove more thoroughly the dead epithelial scales and the fatty substances. Some surgeons scrub the hands in turpentine or benzine before using alcohol. Again, others place much faith in mustard as a disinfectant for the hands. Schleif places great stress upon mechanical cleansing, and for this purpose employs a soap of which marble-dust is an ingredient. Bacteriological experiments have proved that this does not render the hands germ-free as some of the longer established processes.

Recognition of the unreliability of any one plan of hand-disinfection led surgeons as a last resort to seek an envelope for the hand which they could subject to the methods of sterilization in which they had implicit faith. Gloves of various materials, preferably rubber, were found to meet admirably all indications, and their



McBurney, of New York, two years ago, gave gloves a most thorough trial, with results that allow of but one interpretation. In every operation which he performed during a series of five months in his hospital and private practice, during which time he himself, his assistants, and nurses wore gloves, there were evidences of wound infection in but three cases, and at each of these but a single drop of pus at one suture was found. No chemical disinfectant was used during this period in the preparation of the hands, and none in the treatment or dressing of the wound. Other surgeons have since had equally gratifying results, and there seems to be very good reason for believing that gloves have come to stay. While they are particularly useful as a protection to the patient in the prevention of wound infection, they are equally useful in the protection of the surgeon when called upon to dress or handle septic cases. The hospital interne, who, handling as he must, septic cases in his daily routine of duty, could aforesaid with difficulty perfectly disinfect his hands, may now protect himself against frequent contamination by using gloves at his daily dressings. It is true that at first the surgeon's sense of touch is less delicate, perhaps, and his dexterity somewhat impeded, but with time and experience these so-called difficulties will be so nearly overcome that they will no longer be claimed as disadvantages. In some institutions the question of expense will come up for consideration. On the whole, if the gloves are carefully handled and properly taken care of, their introduction should prove to be an economy when their cost is credited with the amount saved in such items as dressing-material, bandages, peroxide of hydrogen, etc.

Rubber gloves may be sterilized by one of the following methods : (1) By boiling : the gloves are boiled in a 1 per cent. soda solution for fifteen minutes and wrapped in a dry sterile towel. Before putting the gloves on, the surgeon thoroughly dries his hands and dusts them with sterile powdered starch. The gloves can then be drawn on with ease. (2) By steam : the gloves are wrapped in a towel and sterilized in an autoclave. This method is no more efficient than the other, and is more injurious. (3) By chemical sterilization : the gloves are soaked in a 1 : 1000 corrosive sublimate solution for at least one hour, and allowed to remain in the solution until the surgeon is ready to use them. In this method the bowl in which the solution is placed should be deep enough to allow the surgeon to keep his whole hand immersed while drawing on the gloves.

The first method is the most satisfactory, taking all things into consideration. If the gloves are put on while immersed in corrosive sublimate solution, a sufficient amount will remain in the gloves after they have been put on to irritate the skin. Furthermore, there is less

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chance of tearing them when the hands are dry and dusted with starch, than when they are wet.

A freshly sterilized pair of gloves should be used at each operation, and before being put away they should be washed with soap-water and ammonia in order to remove all particles of blood, tissue, or wound-secretions. If during the course of an operation they are torn, a sterile rubber finger-cap may be put on. Inasmuch as there is always a chance of a glove being torn during an operation, and as occasions arise in which it may be necessary to remove the glove, quite as much attention should be paid to the disinfecting of the hands as though it were not the intention of the operator to wear gloves.

Mikulicz introduced the cotton glove before the rubber glove was very generally used. Cotton gloves can be recommended only in those cases in which it is impossible to procure those made of rubber. They have but one point in their favor, namely, that they eliminate the possibility of friction between the hand of the operator and the wound, and in so doing eliminate a well-recognized mode of wound-infection. Apart from this they are of little service unless they can be kept dry throughout the operation, for it has been frequently demonstrated that once they become wet microorganisms freely filter through the meshes. It is needless to say that it is much more difficult to handle ligatures, sutures, and instruments with cotton than with rubber gloves. Cotton gloves may be sterilized, with the dressings, by steam. Attempts have been made to render them impermeable by incorporating in the meshes some material such as paraffin, but the results have not been satisfactory.

#### PREPARATION OF THE PATIENT, INCLUDING THE FIELD OF OPERATION.

The importance of a course of treatment preliminary to operation will be better appreciated if one bears in mind the conditions that lead to auto-intoxication—a condition due to the failure on the part of the patient to eliminate certain of the normal products of metabolism which may accumulate in such quantities as to have certain toxic effects. The feces, the bile, the urine, each contain poisonous materials which are manufactured in the human economy as the products of assimilation or metabolism under conditions of perfect health. In health these poisons are eliminated through the various excretories, and the subject suffers no ill-effect therefrom; but if for any reason these channels of elimination are not open, the patient is exposed to the danger of auto-intoxication. If digestion be faulty, if the metabolic processes be arrested or perverted, the conditions are exaggerated. If the kidneys, liver, or intestines are inactive, the

prognosis as to operative recovery will not be so favorable. Upon this fact is based the rationale of preliminary treatment. In order that digestion may be properly regulated and not overtaxed, the diet must for a few days be restricted; in order that the intestinal tract may be rid of all toxic matter, brisk purgation should be induced by the administration of salts. A sluggish liver should be guarded against by the administration of calomel, and the condition of the kidneys must be thoroughly investigated beforehand by a careful urinary analysis. All the avenues by which waste-products are eliminated should be open, all the organs of elimination active. Patients whose general condition favors auto-intoxication are those who most commonly succumb to other forms of infection. Whenever feasible the preparation of the patient should commence several days before operation. During this time he should, when health permits, be given general baths once a day in order to bring about a condition of general cleanliness. His diet should be restricted and daily evacuation of his bowels insured by the administration of fractional doses of calomel, or full doses of salts and castor oil. A careful urinalysis should be made, with particular reference to albumin, casts, and sugar, and the total amount voided in each twenty-four hours recorded.

On the afternoon prior to the day of the operation the field of operation must be prepared. For this purpose the nurse, after properly disinfecting her hands and putting on rubber gloves and a sterile apron, provides herself with a razor, sterile towels, basins, cotton, gauze pads, and a nail-brush. The actual preparation of the skin may be made by any one of the methods recommended for sterilization of the surgeon's hands. The following method, with slight modifications, is most commonly used: (1) Shave the hairy parts. (2) Scrub the skin with soap and water for from five to ten minutes, using a soft nail-brush or gauze pads. The water should be changed at least three times. The area of skin thus prepared should be such as to allow of a good margin in all directions from the proposed seat of operation. If the skin be delicate, the scrubbing should not be too vigorous nor too long continued. (3) Scrub gently with 95 per cent. alcohol for three minutes, using for this purpose a gauze pad. (4) Douche the parts freely with corrosive sublimate (1 : 1000). (5) Apply a gauze dressing saturated with a 1 : 2000 corrosive sublimate solution, and secure in place with bandage. This may be modified in several ways: a soap poultice may be applied to the surface for six to eight hours before commencing the preparation. Benzine or turpentine may be used as a means of removing the fatty and oily substances, as adjuvants to alcohol. Ether has been used after the alcohol for a like purpose. A dressing saturated with salt solution or a dry



dressing may take the place of a wet bichloride dressing. Formalin has of late years received a high endorsement as a disinfectant of the skin. It is claimed for the formalin method that formaldehyde gas penetrates the deeper layers and follicles of the skin, and may be counted on to render the skin sterile in 80 to 90 per cent. of cases (Landerer). The following are the directions: after shaving and scrubbing with soap and water, a 1 per cent. formalin solution is applied in the form of a poultice for twelve to thirty-six hours, during which time the poultice must be frequently changed. The parts are then washed with alcohol (90 per cent.) for one minute, and with corrosive sublimate (1:1000) for two minutes. Whatever the method selected, particular attention should be paid to those regions in which organisms are more abundant and more deeply seated; these include the hairy regions, the regions in which sebaceous glands abound, places where the cutaneous surfaces are more or less in contact, as the axillæ, the groin, the folds of a pendulous abdomen, the region of the umbilicus. It must not be forgotten that there is the widest range in the toleration of the skin of different individuals; the method which in one patient will have no harmful effect may in another patient give rise to a dermatitis, in the presence of which it would be imprudent to operate.

On the morning of the operation, according to the preference of the surgeon, the fields of operation may or may not be prepared again in the manner prescribed for the preliminary preparation. A clean shirt should be put on, and in order to avoid too much exposure the patient should wear a pair of cotton-flannel leggings reaching from the toes to the perineum.

At 6 P.M. on the eve of the operation the patient is given one-half ounce of Rochelle salt or an ounce of castor oil; this dose to be repeated at 10 P.M. if the first was ineffectual.

On the morning of the operation breakfast should consist of one glass of milk or a cup of broth, with one piece of toast. After this the patient should receive nothing by mouth if the operation is to be performed about midday. In general, it may be said that no food, either liquid or solid, should be taken by mouth during the six hours preceding the operation. It may be that the patient may require stimulation during this period, in which case the stimulant may be given by rectum or in small quantities by mouth.

Four hours before the operation an enema should be administered, composed of two ounces of glycerin and one pint of soapsuds and water. In operations upon the lower alimentary tract a second enema should be administered one hour before the operation. When the condition of the patient allows, he is to be directed to use the commode rather than the bed-pan. Immediately before the patient is brought

to the operating-room the bladder must be evacuated—by catheterization if necessary.

**Preparation of Special Regions.—a.** In all operations upon the HEAD, whether or not it is intended to open the cranial cavity, the entire scalp should be shaved. The dandruff may be softened and its removal thereby facilitated by the application of sweet oil or a soap poultice. Owing chiefly to the vascularity of the parts operative wounds of the scalp rarely become infected.

**b. THE MOUTH AND PHARYNX.**—In these regions, even in health, a great variety of organisms is found, both pathogenic and saprophytic. Despite this fact infection does not often follow wounds of the mouth, because the virulence of the organisms is never very great, and because the rich blood-supply of the part enables it to combat bacterial invasion. Strong antiseptics obviously cannot be used, so that the preparation must depend upon the mechanical removal of as many organisms as possible with the aid of mouth-washes. In the Massachusetts General Hospital the preparation of the mouth for operation is as follows: the teeth are examined and all cavities filled; the mouth is rinsed out, the teeth brushed, and the pharynx and tonsils sprayed with an antiseptic solution. The following formula is most efficient, and at the same time least injurious to the teeth:

R <sub>x</sub> Acid. benzoic.,	3;
Tinct. eucalypt.,	15;
Alcohol,	100;
Olei menthæ piperitæ,	0.75.—M.

Sig. To half a wineglassful of water add enough of the solution to produce distinct clouding. Hold in the mouth for one minute.<sup>1</sup>

This preparation of the mouth is to be recommended in all cases of general anæsthesia, in order to minimize the danger of septic pneumonia.

**c. THE EYE.**—The face in the region of the eye should be disinfected as well as possible. Strong antiseptics are absolutely contraindicated in the preparation of the eye itself, so that reliance must be placed upon the mechanical removal of organisms by eye-washes, boric acid, or normal salt solutions, especial attention being paid to the margin of the lids and the orifice of the lachrymal duct, where the organisms are most abundant.

**d. THE NECK.**—In the preparation for operation upon the face or cervical region the patient's head should be covered with a piece of sterile gauze, which should be applied firmly enough to prevent it slipping off at any time during the operation. This is best accom-

<sup>1</sup> Warren's *Surgical Pathology*.



plished if the gauze is folded in the shape of a triangle and applied as one would a handkerchief bandage. The anæsthetizer should prepare his hands as carefully as though he were going to assist in the operation, for there is constant danger of the hands coming in contact with the wound, sponges, or instruments; he should wear a sterile apron, and should administer the anæsthetic upon a piece of sterile gauze or a cone wrapped in sterile gauze.

*e. THE THORAX.*—When there is any liability of the operation extending to the axilla, as in amputation of the breast, the field of preparation should include the axilla as well as the entire arm and forearm on the side involved. For these operations it is also advisable to envelop the hand in sterile gauze.

*f. THE ABDOMEN.*—Disinfection of the skin for operations in this region is most important, since the peritoneal cavity is almost always opened. The skin in and about the umbilicus and in the neighborhood of the pubis requires the most attention. The preparation of the patient should begin preferably several days before any operation involving the gastro-intestinal tract, which even in a state of health is the habitat of so many organisms, many of them pathogenic. In a series of experiments conducted by Cushing it was found possible by sterilizing the ingesta and by fasting a few hours to bring about a state of amicrobism in the stomach and upper intestinal tract; a condition which would reduce to a minimum the danger of infection. Active peristalsis, a thoroughly evacuated bowel, and a state of amicrobism are the desiderata in operations invading the gastro-intestinal tract. To bring about such a state of affairs necessitates restriction of diet, mild purgation, the sterilization of the ingesta, and fasting several hours prior to the operation. These are all practical suggestions, and will materially lessen the possibility of subsequent complications, and in so doing permit of a more favorable prognosis in every case.

If the stomach or duodenum is to be attacked, lavage should be practised immediately before the operation, with a view to evacuating entirely the stomach contents.

In operations upon the lower alimentary tract, as the anus and rectum, an enema should be given immediately before the operation, and the rectum well irrigated with boric acid or salt solution. The skin in the neighborhood of the anus should, of course, be disinfected.

*g. THE GENITO-URINARY TRACT.*—In a state of health this tract from the kidneys to the anterior urethra is sterile; from the compressor urethræ to the external meatus a great variety of organisms may be found. In the immediate region of the meatus and around the external genitalia the organisms are in greatest abundance.

Disinfectants adaptable to sterilization of cutaneous surfaces are

unsuitable for mucous membranes; therefore, disinfection of the urethra or the bladder, if infected, must be mechanical, and necessarily imperfect. In operative intervention upon any portion of the genito-urinary tract it is desirable that a large amount of urine be secreted, and that the urine be sterile or, better still, slightly inhibitive in its action.

The patient should be instructed to drink water freely, in order to increase the amount of urine secreted, and, if necessary, diuretics may be administered for this purpose. The so-called urinary antiseptics, especially boric acid, in doses of 10 grains, in pill or capsule, three times daily; salol in capsule, 4 grains, three or four times daily; and urotropin, 20 grains daily, in divided doses, exert a favorable action upon pre-existing infections, and are useful as prophylactics. A preliminary course of treatment in operations upon this tract should never be omitted when time allows. It includes the administration of urinary antiseptics, of liberal quantities of diluents, with diuretics if necessary, and a urinalysis, including an estimation of the amount voided in each twenty-four hours.

The possibility of having to resort to the perineal or suprapubic route to gain entrance to the bladder must be borne in mind in preparing for operations upon the bladder. The skin over the external genitalia, including the perineal and suprapubic regions, should be shaved and properly disinfected. The patient should urinate in order to flush the anterior urethra; the glans penis is then swabbed with a 1 : 2000 corrosive sublimate solution, and the anterior urethra irrigated with saturated boric acid solution, permanganate of potassium solution (1 : 10,000), or normal salt solution. These solutions should always be warm. No further preparation will be required when the bladder is not the seat of infection. If there be a cystitis, the bladder should be irrigated daily, for a period of at least two weeks, with the solutions already mentioned; and if irrigation be combined with permanent catheterization during the same period, the bladder will be as free from organisms as it is possible to render it. The organisms that have invaded the mucous or submucous coats cannot, of course, be affected by any method of disinfection.

*i. THE EXTREMITIES.*—The feet and hands, especially in the region of the nails, are always difficult to disinfect, more particularly so with the laboring classes, into whose hands dirt and grease are thoroughly ground. If the operation does not actually involve either the hands or feet, the latter, immediately before the operation, after the patient is on the table, should be wrapped in sterile gauze or in a towel secured in place by a sterile bandage. They can then be handled or manipulated by operator or assistant, as is often necessary, with impunity. If the operation is to include the foot or hand, the

application of poultices, soap or flaxseed, on several preceding days will facilitate the removal of the dirt and grease; each day the poultice should be removed and the parts scrubbed with soap and water, alcohol, and bichloride. The nails should be manicured and callosities pared off.

#### PREPARATION OF LIGATURES AND SUTURES.

The question as to what is the best ligature and what the best suture material has caused almost endless discussion. Whether it should be absorbable or non-absorbable, sterile or antiseptic, is the question that presents itself for solution. The introduction of catgut years ago was hailed with delight, and catgut was regarded as the ideal material for buried sutures and ligatures. When operative technique had reached that state of perfection in which infection was the exception rather than the rule surgeons at once became suspicious as to the sterility of the catgut they were using, and held it responsible for many of their unlooked-for wound-infections. As a matter of fact, it is known to-day that the operator's hands are in most instances the guilty agents; and whatever objections there may be against catgut, none can be sustained which does not admit that catgut can be rendered perfectly sterile. But objections have been raised against catgut, and at the present time the pendulum of popularity is beginning to swing back in the direction of silk. Catgut is objected to, first, because it furnishes excellent culture-material for organisms, which may, despite every precaution, in the course of an operation gain entrance to the wound; and when the catgut becomes absorbed the organisms contained therein are liberated and give rise to infection of the adjacent tissues; secondly, because a strand two or three times as large in diameter must be used in order to get the same tensile strength as silk; thirdly, that it swells after it becomes moist, making it difficult to thread needles; fourthly, that it is slippery and more difficult to handle than silk; fifthly, that the methods of sterilization are more complicated and more costly than those required for silk.

There are still, however, many surgeons and gynecologists actively engaged in operative work who are staunch advocates of catgut, and with them I believe that, granted its sterility, it is still the most desirable material for ligatures and buried sutures. Should it be necessary to employ a material which does not undergo absorption quickly, catgut, if prepared by the formalin or chromic acid method, will meet every indication. Should the surgeon prefer to employ antiseptic ligatures, he may still use catgut prepared by the silver method. In suppurative wounds catgut is in many ways superior to silk, and in wounds of the mucous membrane difficult of access catgut



may be used in order to avoid the necessity of removal. There is scarcely an operation requiring a buried ligature or suture material in which catgut, prepared in one of the following ways, does not fill all requirements. There is one very great objection to catgut, however: the apparatus required for its sterilization is only accessible in hospitals, is more or less expensive, the methods complicated, and only reliable when carried out by an experienced person. On the other hand, silk can be rendered sterile by simply boiling for a few minutes in a soda solution, and is therefore better adapted to country or private practice. If the physician practising in the country wants particularly to use catgut, he had better secure it already prepared from a reliable manufacturing firm.

Catgut can be procured in six sizes—00, 0, 1, 2, 3, and 4. Double nought is the finest, suitable only for ligating very small bleeding points or suturing delicate structures. The next two sizes—0 and 1—are still quite fine; and, with No. 2, are the sizes most commonly used. Nos. 3 and 4 are very heavy, and only required for the ligation of pedicles or in the retaining of bony fragments. In operations for the radical cure of hernia or in closing the muscular layers of an abdominal wound No. 2 would be strong enough.

The value of catgut was materially enhanced when methods were perfected by which it could be subjected to sterilization by heat; a method in which absolute reliance can be placed. The following are the methods, mentioned in order of efficiency, which have proved the most reliable:

1. THE CUMOL METHOD.—(1) The gut is cut into lengths of thirty-three centimetres, and bundles of twelve strands are twisted in rings of a size to fit the heavy glass ignition tubes used as receptacles. (2) These rings are dried at a temperature gradually raised to 80° C., and held at that point for an hour. This exposure dries every bit of moisture from the material, and prevents the gut becoming brittle during the subsequent steps of the preparation by forming a glue-like substance on its fibres. (3) The gut is now immersed in cumol, the temperature of which is slowly raised to 165° C., and maintained there for an hour. The process is completed by pouring off the liquid and drying the catgut at a temperature of 100° C. until the excess of cumol entirely drains off. (4) The catgut is finally transferred to sterile tubes, plugged with sterile cotton, and stored within heavy glass jars previously sterilized.

Cumolization is best accomplished by the use of Clark's apparatus (Fig. 23). It consists essentially of a sand-bath, enclosing a chamber, which is furnished with an inlet above and an outlet below, and contains the bulb of a thermometer in a wire basket suspended from a rod perforating its roof. In using the apparatus the gut is



placed in the wire basket, the rod is lowered, the lid clamped and shut, and the temperature raised to the desired point. When the drying is complete the cumol is poured in at the top and the temperature raised to just below the boiling-point. An hour later the cumol

FIG. 23.



Clark's apparatus.

is drawn off by opening the stopcock at the bottom of the reservoir; this is left open, while the temperature of the chamber is continued at about  $100^{\circ}$  C. The air entering below becomes intensely hot, circulates through the chamber, and dries off every vestige of cumol through the aperture above. After this has been accomplished the sterilizer is opened and the gut transferred to previously sterilized glass tubes. This transfer is made by nurses, who observe every aseptic precaution. Their hands and arms are thoroughly disinfected, they wear

sterile gowns, and handle tubes and gut with sterile rubber gloves and tissue-forceps.

Catgut thus prepared is dry, flexible, and of great tensile strength, not to say sterile.

2. THE ALCOHOL METHOD.—(1) The strands of catgut are wound on glass reels or bobbins, and a number of these placed in a metallic cylinder or tube so constructed as to be absolutely air-tight. (2) The cylinder or tube is partially filled with absolute alcohol, making allowance for evacuation. (3) The cylinder is immersed in boiling water for one hour, or placed in an autoclave at a temperature of  $115^{\circ}$  C. for forty-five minutes. The catgut is not removed until the time for using.

FIG. 24.



Various receptacles for storage and sterilization of ligatures. 1, glass jar with spools of silk immersed in a corrosive-sublimate-alcohol solution, 1:1000. 2, glass jar with silkworm-gut. 3, Hirst's formalin tube for boiling catgut in alcohol under pressure. 4, box for sterilization and storage of silk. The box contains the spools from which the silk is drawn through openings in the stationary cover. When subjected to sterilization the front and top lids are closed; when not in use both lids are closed; when in use the top lid is thrown open. Thus the interior of the box is never exposed except during sterilization. 5, jar containing tubes for sterilization and storage of ligatures and sutures in the dry form. 6, metal jar for boiling catgut in alcohol under pressure. 7, glass box for storage of catgut or silk in wet form. The smaller receptacle on top, which contains three reels, around which the catgut or silk is wound, stands in the larger receptacle. The ligatures and sutures can be drawn through holes in the top of the smaller receptacle, so that the reels are never subjected to the danger of contamination. 8, round glass dish in which are kept those ligatures and sutures that are likely to be used during the operation.

In certain instances it is desirable to prepare catgut in such a way that it will not undergo absorption for two or three weeks. For this purpose the catgut is impregnated with formalin or chromic acid in one of the following ways:

3. FORMALIN METHOD (HIRST'S METHOD).—(1) Soak commercial gut in benzine for twelve hours. (2) Unroll and dry in the open air for twelve hours. (3) Place in a 5 per cent. solution of formalin for twelve hours. (4) Take out of formalin, tie all strands



together, and stretch on frame as tight as possible. (5) Let dry at least four days. (6) Cut strands of desired length, and wind gut on the spool of a "Hirst formalin tube,"<sup>1</sup> taking care that one strand does not cross another. (7) Fill tube with a 5 per cent. glycerin solution in absolute alcohol, and hermetically seal. It must be absolutely air-tight. (8) Place in autoclave (temperature 115° C.) for forty-five minutes. (9) The catgut is not removed from the tube until it is used.

4. CHROMIC ACID METHOD.—(1) Add 100 parts of catgut to 200 parts of carbolic acid, 2000 parts of water, and 1 part of chromic acid. (2) Allow it to remain in the solution for twenty-four hours. (3) Transfer to ether or 80 per cent. alcohol. Catgut so prepared will last from three to six weeks, according to the size of the gut (Fig. 25).

5. LACTATE OF SILVER METHOD.—(1) Soak for one week in a solution of lactate of silver. (2) Dry thoroughly. (3) Place in 95 per cent. alcohol. (4) At the end of twenty-four hours it is ready for use. The advocates of antiseptic ligature material, and of the so-called silver treatment, have used this method with perfect satisfaction. Catgut so prepared is not only sterile, but strong; not slippery, and requires a longer time for its absorption.

6. FORMALDEHYDE METHOD.—(1) Place the skeins of catgut in a jar of 2000 to 6000 cubic centimetres capacity, in which has also been placed a small glass beaker, containing a dozen paraform pastilles, over the top of which is placed a cover of copper gauze. (2) Close jar with tightly fitting stopper and leave undisturbed for three days, at the end of which time the catgut is ready for use. It is claimed for this method that the catgut is perfectly sterile and loses none of its tensile strength or flexibility.

KANGAROO-TENDON is occasionally used as an absorbable buried suture. It is usually regarded as being stronger than catgut and not so quickly absorbed, therefore better adapted to operations in which it is desired to afford the parts proper support until repair has taken place. Thus in operations for the radical cure of hernia, for fracture of the patella or long bones, it may with propriety be used. Silver wire has gradually taken its place in operations upon bones. Kangaroo-tendon may be prepared by the cumol or chromic acid method, and lasts from four to six weeks.

The non-absorbable materials are, (1) silk, (2) silkworm-gut, (3) silver wire.

<sup>1</sup> The Hirst formalin tube, manufactured by Charles Lentz & Sons, is a metal tube five and a half inches long and one and a half inches in diameter, one end of which is permanently closed by a screw cap, provided with a rubber washer, which, when tightly screwed down, makes the tube air-tight. Within the tube is a long spool of willow upon which the catgut is wound.

**SILK.**—Sufficient has been said of the relative merits of silk and gut as material for ligatures or sutures. Surgeons' cable twist silk may be purchased in five sizes, Nos. 1 to 5. No. 1, the finest, is used

FIG. 25.



Method of storage of ligatures and sutures in the dry form. 1, tube with catgut sterilized by cumol method. 2, tube with spools of silk sterilized by steam. 3, tube with silkworm-gut sterilized by steam. 4, 5, tubes containing needles already armed with silk sutures, which are wound around plugs of gauze.

only to secure the smallest bleeding points and to suture delicate structures, as the peritoneum or dura mater; No. 2 is heavy enough to ligate all bleeding points except the larger vessels, and is a suitable size to employ in suturing the skin and subcutaneous structures; Nos. 3 and 4 may be used for ligating the large arterial trunks, and as



deep sutures which are to approximate the muscular layers; No. 5 is used chiefly in the ligation of pedicles.

Sterilization of silk may be effected in one of the following ways:

(1) Wrap the silk on spools and boil in a 1 per cent. soda solution for fifteen minutes, and store it in a solution of alcohol and corrosive sublimate (1:1000). This method is employed by those who prefer antiseptic to sterile ligatures.

(2) Wind upon glass bobbins or spools, place within ignition tubes, which are plugged with cotton, and sterilize by the fractional method in the steam sterilizer.

(3) Silk may be impregnated with metallic or lactate of silver solution after the method employed in the preparation of silver catgut.

SILKWORM-GUT is the material *par excellence* for cutaneous sutures; it is used for no other purpose. It is readily sterilized, is non-absorbent and non-irritating; for all these reasons it can be left *in situ* longer than silk. Silkworm-gut may be purchased in bundles of seventy-four to one hundred strands, about twelve inches long, in two sizes, coarse and fine. It may be sterilized by any of the methods suitable for silk; if sterilized in the dry state, it should be soaked in sterile water a short time before using, in order to render it more pliable.

SILVER WIRE has been advocated by those who place confidence in the antiseptic property of silver in the presence of wound-fluids. It has been used in a limited way for a number of years as a cutaneous suture, and in operations upon ununited fractures. More recently it has been employed as a permanent buried suture in the closure of the deep muscular layers, and has given general satisfaction. It may be purchased in different sizes and sterilized in the same way as metallic instruments.

A well-equipped clinic should be supplied with the following in order to meet every emergency:

1. At least four sizes (Nos. 0, 1, 2, and 4) of catgut prepared by the cumol or alcohol method; and Nos. 2 and 4 prepared by the formalin method.

2. Three dozen strands of medium-sized silkworm-gut, in packages of a dozen each, which may be boiled either in water or in alcohol in the jars in which they have been stored.

3. At least four sizes of silk (Nos. 1, 2, 3, and 4), rolled on reels or spools, which may be preserved in 95 per cent. alcohol alone, alcohol and corrosive sublimate (1:1000), or in sterile ignition tubes, all to be resterilized before using.

It will often expedite matters and prevent delay during the course of an operation to have a certain number of needles already armed

with different sizes of silk. A half-dozen tubes may be filled as follows :

One containing six straight intestinal needles armed with No. 1 silk.									
One	"	"	curved	"	"	"	"	"	"
One	"	"	straight Hagedorn	"	"	"	"	2	"
One	"	"	"	"	"	"	"	3	"
One	"	"	curved	"	"	"	"	2	"
One	"	"	"	"	"	"	"	3	"

The sutures are cut twelve inches long, and after the needle is threaded are wound around a small plug of gauze, through the long axis of which the needle is finally passed.

#### 4. Three sizes of silver wire.

In whatever receptacles the various sutures and ligatures are kept, they should, if possible, never be handled after they have been sterilized, unless with rubber gloves, and should under no circumstances be drawn between the naked fingers. There is no surer way of infecting a suture than by drawing it between the naked fingers. The nurse or assistant should, therefore, be instructed to handle all sutures and ligatures with dressing-forceps on every possible occasion. One of the great advantages of having the needles threaded before sterilization is the avoidance of the necessity of handling the suture material. There is never any excuse for a ligature being infected before it reaches the surgeon; the nurse grasps the end with the forceps, unravels the spool, cuts the ligature the desired length, and hands it directly to the operator.

### STERILIZATION OF INSTRUMENTS.

Since instruments are now made of metal throughout, their sterilization is a matter of the utmost simplicity. The best and simplest method is as follows: the instruments are first placed in the instrument-sterilizer, which is a metal tray of suitable size, divided by small partitions into compartments; at one corner on a level with the bottom there is a small outlet fitted with a stopcock. The instruments are systematically arranged on the tray and boiled in a 1 per cent. sodium carbonate solution for ten to fifteen minutes. The soda not only prevents rusting, but, as pointed out by Schimmelbusch, adds to the bactericidal effect of the solution. After fifteen minutes' *actual boiling* the soda solution is drained off through the outlet, and enough sterile water, or, better still, a 1 per cent. soda solution, poured on to immerse the instruments thoroughly. After the operation is over the instruments should be washed first in cold water, which facilitates the removal of fragments of tissue and blood, then scrubbed with soap and hot water, boiled in a 1 per cent. soda solution, and finally wiped thoroughly dry and put in the instrument-case. Cared for

in this way, instruments may be kept for a long time without rusting. If the sterilizer in use be a stationary one, it should contain one or more wire baskets, in which the instruments, after sterilization, can be transferred into a previously sterilized agate or glass tray of a suitable size. During the operation they had better be kept immersed in a soda solution or sterile water; this will prevent particles of dust settling upon them, and will in a measure prevent rusting.

It is a much better plan to sterilize instruments in boiling water than in steam, not only because it economizes time, but because it is less injurious to the instruments; but no matter what the method adopted, all are more or less injurious to cutting instruments. In order to preserve their cutting edge knives should not be boiled longer than five minutes, a period sufficiently long to insure sterilization.

Those articles which are made of hard rubber and leather, or of any material that cannot be subjected to heat, such as syringes, must be sterilized by immersion in a 1:20 carbolic acid solution for at least one hour. Such delicately constructed instruments as cystoscopes are best sterilized by exposure to formaldehyde gas for a period of twenty-four hours.

#### PREPARATION OF DRESSINGS AND SPONGES.

**Dressings.**—Since the abandonment of antiseptic dressings—dressings impregnated with various antiseptics, such as corrosive sublimate, carbolic acid, salicylic acid, or cyanide of mercury and zinc—the sterilization of dressings, as of instruments, is a matter of the utmost simplicity. The material selected is one which affords proper protection to the wound, and at the same time promptly absorbs the wound-discharges. Absorbent cotton and gauze (cheesecloth) meet these indications well, and are now used practically to the exclusion of all other materials. The old straw and bran, tow and moss, wood and sawdust dressings have been relegated to the shelf.

The substitution of sterile for antiseptic gauze as a dressing-material is only another manifestation of the change from an antiseptic to an aseptic technique. If the wound has not been infected at the time of operation, there is no danger of its being contaminated from organisms in the air providing the wound is protected with a sterile dressing. From experience we know that organisms do not penetrate, and, furthermore, do not grow or flourish, in a dry dressing. If the wound-discharges have saturated the entire dressing, it should either be changed or reinforced, for blood and serum are excellent soil for the growth of microorganisms. On the other hand, antiseptic gauze is not by any means always bactericidal, and therefore cannot be depended upon to destroy organisms that may be



deposited in its meshes. Furthermore, it is not as absorbent as the unimpregnated material. For these reasons alone sterile is to be preferred under most circumstances to antiseptic gauze. The sterilization of gauze and absorbent cotton is best effected by the fractional method in a steam sterilizer. The gauze and cotton, cut in convenient sizes, are wrapped in a package with a towel or piece of muslin, and placed in the sterilizer for forty-five minutes at a temperature of 240° F. on three successive days. The spores which survive the first sterilization slowly grow into adult form, and these are destroyed at the two subsequent sterilizations. Most hospitals are equipped with stationary sterilizers, known as autoclaves, which are connected directly with steam pipes, although in some the desired heat is supplied by gas. The portable Arnold sterilizer is much cheaper, but differs from the others in that the dressings are not sterilized under such high pressure, a fact which insures penetration of the steam into large and tightly wrapped packages.

The dressings may be dried by allowing them to remain for an hour after the steam has been turned off from the dressing-chamber, and circulates only in the jacket.

Upon removal of the dressings a convenient receptacle should be at hand in which they can be stored. Such a receptacle should be made of metal—tin will do—and should have a tightly fitting lid in order to keep out the dust.

Dressings that must be transported either to different parts of the hospital or to private houses may to advantage be sterilized in metal boxes, in which they can be carried about without risk of contamination. At the Roosevelt Hospital, New York City, these boxes are about one foot square and four inches deep, with a detachable lid. In one end of the box is a series of openings, which may be wholly occluded by a revolving disk with openings corresponding to those in the box. By a partial revolution of the disk the openings of the box and disk no longer coincide, and all communication between the cavity of the box and the outside air is cut off. The lid is so arranged that when the disk is open the lid is slightly raised, and when the lid is closed the disk is automatically closed and locked in position.<sup>1</sup>

Dressings and other materials in preparation for an operation should be put in the cage of the autoclave, and the cage enveloped in a sheet of two or three thicknesses. When the surgeon and assistants are ready to begin the preparation of their hands, and not before, the cage should be removed from the autoclave and carried into the operating-room. All the articles required for the performance of the operation—towels, sheets, sponges, pads, and dressings—are taken, when required, directly from the cage either by the assistant or nurse.

<sup>1</sup> *International Text-Book of Surgery.*



By the observance of these directions every possible chance of contamination between the time the dressings were sterilized and the time they reach the operator's hands is excluded.

**IODOFORM GAUZE.**—While surgeons have very generally discarded antiseptic gauze as a protective dressing, a number still employ it in tamponning or dressing wounds already septic. Iodoform acts unquestionably as a disinfectant and deodorizer in the presence of infected wound-secretions. It is particularly useful as a protective dressing for wounds constantly exposed to some source of contamination, as are those in the anal region, and is very generally used in wounds and cavities of a tubercular nature. One objection to iodoform gauze may be alluded to: if used in the dressing of wounds, one cannot tell by the sense of smell whether the dressing contains pus; the odor of the latter, if present in moderate quantities, will be disguised by the iodoform.

The room in which the gauze is to be prepared should be as free from dust as possible; walls, floor, and furniture should be wiped with wet antiseptic cloths. The nurse is prepared as if for an operation, wearing a sterile apron and rubber gloves. To a quart of normal salt solution enough castile soap is added to make a good lather, and to this is added a quarter of a pound of iodoform gauze. With this the gauze which has been previously sterilized is impregnated, cut at convenient lengths, and folded into small packages, which are wrapped in waxed paper. The waxed paper is sterilized the day it is used, and is immersed in 1:40 carbolic acid solution immediately before it is wrapped around the gauze. These packages are stored in perfectly sterile jars.

**SUBLIMATE GAUZE.**—(1) Soak plain gauze for twelve hours in a 1:500 sublimate solution. (2) Dry. (3) Sterilize by the fractional method.

**Sponges.**—For the purpose of keeping the wound dry during an operation marine sponges have given way altogether to sponges made of gauze or cotton. While the latter are neither so absorbent nor so pliable as marine sponges, they are more easily sterilized, and so very much cheaper that one can afford to throw them away after they have been used but once. Objections are made to marine sponges because they are expensive, and because they cannot be sterilized by heat. Gauze "sponges" are made about three inches square, wrapped in packages of one or two dozen, and sterilized in the same way as the dressings. A gauze "sponge" is made by folding a piece of gauze, about twelve inches square, in such a way that it retains its shape without being stitched and hemmed, and without leaving exposed any free edges which may unravel. When so folded each pad consists of sixteen layers.

In operations involving the abdominal cavity it is convenient to have these pads or sponges of different sizes; the larger ones are used to wall off the intestines, the smaller as sponges. A laparotomy set should contain a dozen pads of the following dimensions: three, six inches square; three, four inches square; and the remainder, two and a half inches square. The pads are made of pieces of gauze folded in the desired form and dimensions. In order to lessen the risk of losing or leaving a pad in the abdominal cavity after closure of the wound, a piece of tape eight inches long may be sewed to each corner. In this way track is easily kept of each pad.

Sponges are sometimes made by wrapping a ball of absorbent cotton, about two inches in diameter, in a piece of gauze, the corners of which are brought together and tied with a piece of silk. They are not so absorbent as those made altogether of gauze.

Marine sponges, while far superior, are not used extensively for reasons already mentioned. They may be prepared as follows:

(1) Beat while dry to remove as much sand as possible. (2) Rinse in twenty changes of water. (3) Soak for twenty-four hours in muriatic acid, one fluidounce to the pint, and wash in several changes of water. (4) Soak for ten minutes in a solution composed of:

Permanganate of potassium,	3ij;
Sodium hyposulphite,	3j;
Muriatic acid,	3ij;
Water,	Oij.

(5) Wash in several changes of water, to the last of which a few drops of aqua ammonia are added. (6) Transfer to sterile jars filled with carbolic acid solution (1 : 40).

#### STERILIZATION OF BASINS, TRAYS, PITCHERS, AND IRRIGATING-JARS.

Since aseptic operations are conducted upon the principle that every article is sterile at the outset, the receptacles for the solutions, instruments, and sutures must be subjected to equally stringent methods of sterilization. While glassware is perhaps more attractive in appearance, agateware is on the whole undoubtedly the most serviceable. The sterilizing plant should include a square or round metal receptacle large enough to hold all the basins, pitchers, and other utensils that may be required, and these are disinfected by steam or boiling water. They can be sterilized equally well in the autoclaves; but these are more expensive, and are not, as a rule, large enough for the purpose. If these facilities are not afforded, the utensils must be immersed in a 1 : 1000 corrosive sublimate solution

for several hours, in order to insure their sterilization. For the dressing of cases in the wards it is well to boil the requisite number of pitchers, basins, and instrument-trays every morning, and keep them during the day in a large tub containing 1:1000 corrosive sublimate solution. In this way all the needed utensils are preserved in a sterile state.

#### STERILIZATION OF WATER.

Before using water for surgical purposes it should be both filtered and boiled. Ordinarily, when water comes from an uncontaminated source it will be necessary only to boil it in order to render it fit for

FIG. 26.



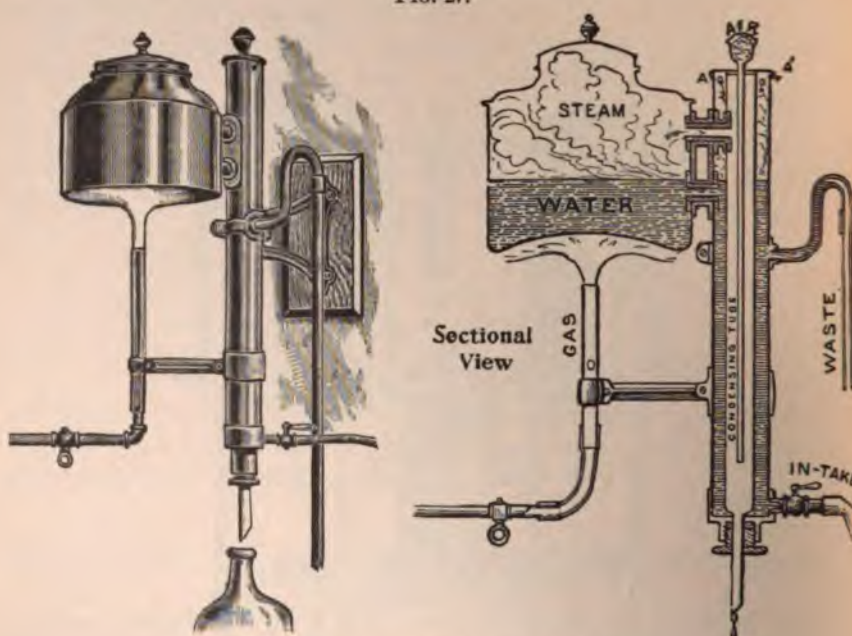
Water-sterilizer, constructed for gas heat or steam heat.

use. When possible, however, it is better to remove all foreign matter by filtration before subjecting it to sterilization. Unless proper precautions are taken, the water will be contaminated before it comes in contact with the wound; thus it may be drawn from a tap that is not sterile or conveyed in a receptacle that has not been sterilized. When only moderate amounts are required the water may be steril-



ized and stored in glass flasks of one or two quarts capacity. This is a simple yet reliable way of procuring perfectly sterile water. When large amounts are required, as in large hospital services, the stationary hot- and cold-water sterilizers have been found to be almost indispensable (Fig. 26). These sterilizers are constructed for either gas or steam heat, and have both a hot and a cold reservoir. The water is sterilized by boiling for thirty minutes under ten pounds pressure. Inasmuch as there is always a chance of the pipe's outlet becoming contaminated by the air, there is always this one opportunity for the water becoming infected after it leaves the reservoir. To guard as far as possible against this source of infection, the pipes

FIG. 27.



Parmelee aerating water still and sterilizer.

should be sterilized themselves at least once a day by flushing them with boiling water. For small private hospitals, or for offices, the Parmelee still and sterilizer is the most serviceable apparatus on the market. It is compact, inexpensive, and combines both a distillery and a sterilizer (Fig. 27).

#### CONDUCTION OF AN ASEPTIC OPERATION,

The well-equipped hospital has to-day an operating-room with more or less luxuriant appointments, in which the performance of an operation on aseptic principles is attended with no difficulties. The



FIG. 28.



1, operating-table. 2, 3, glass-top tables. 4, stock solution stand. 5, irrigating stand. 6, electrical motor engine. 7, instrument-case. 8, wall stand. 9, hot-water tap from water-sterilizer. 10, cold tap from water-sterilizer. 11, supply-chest. 12, medicine-case. 13, bed. 14, instrument-sterilizer. 15, basins, etc., sterilizer. 16 and 17, autoclaves. 18, hot-water sterilizer. 19, cold-water sterilizer. 20, sink for preparation of hands. 21, glass-top table. 22, stationary washstand. 23, bath-tub. 24, chair.

operating-plant consists of four rooms, all communicating with the central room; one being used as an etherizing-room, in which the

FIG. 29.



Private operating-room, University Hospital, showing skylight reaching from ceiling almost to the floor.

dressings, instruments, and all supplies may be kept; the second, as

the sterilizing-room; the third, as a dressing-room for the surgeon and his staff; and the fourth, as the operating-room proper (Fig. 28). The requirements of a well-appointed operating suite are now thoroughly understood; and all designed to make it possible to keep floor, walls, and ceilings free from dust. Around the walls is a wainscoting of white glazed tiles; the remainder of the walls and the ceiling are covered with hard finished plaster, and one or more coats of enamelled paint. The floor is paved with a non-absorbent material, the most suitable being marble or white tiling, and is graded so that there is from all sides a gradual slope

FIG. 30.



Private operating-room, University Hospital, showing aseptic hospital furniture.

toward the centre or one corner, at which a drain is stationed. There are no angles where dust may collect at the junction of the walls with ceiling or floor, nor at the four corners of the room. The operating-room faces north, and is supplied with light by day through a skylight directly over the operating-table extending all or part way to the floor (Fig. 29), and by night by a cluster of gas-jets or electric lamps. All the fittings must be so arranged as to be quite accessible and easily kept clean. The furniture, which includes a medicine- and a supply-chest, instrument-case, an irrigating-stand, a stand for stock solutions, a stand for bowls with solutions for operator's hands, the operating-table proper, and three tables (each twenty by fifty inches), are all constructed of glass and metal with enamel finish (Fig. 30). Each piece of furniture should be supplied with three-inch castors, so that it can be moved about without difficulty, either in cleaning



the rooms or in arranging for the operation. The sterilizing-room contains a sterilizer for hot and cold water, one or two autoclaves, an instrument-sterilizer, a sterilizer for basins and other utensils, and a stationary stand large enough for at least four individuals to disinfect their hands at the same time. The dressing-room contains a stationary washstand and a bath-tub.

#### CARE OF THE OPERATING-ROOM.

This must be placed in the hands of a perfectly trustworthy, responsible, and painstaking individual; one who is intelligent enough and conscientious enough to carry out to the letter every clause in the technique. It is essential that the amount of dust circulating in the operating-room be reduced to a minimum, and to this end the hose and moist cloths must be used frequently to keep the walls, floor, and furniture free from dust. If many septic cases are included in one's service, the entire suite of rooms should be disinfected at certain intervals with formaldehyde gas. It would be safer to have a room set apart for septic cases, in order to avoid having to bring them into the general operating-room.

#### THE OPERATION.

The number of assistants and nurses that will be required varies, of course, according to the nature of the operation, but in every case one does well to reduce the number to the lowest limit. In every additional pair of hands lies an additional source of infection, and for this reason, if for no other, this suggestion should be taken to heart. In fixing upon the number of assistants the surgeon, of course, first consults the interests of the patient; secondly, his own; but these interests cannot, after all, well be differentiated, for what benefits are derived by the patient from a successful operation will alike accrue to the credit of the operator. The conscientious surgeon aims to conduct each operation with as much dexterity and, at the same time, as thoroughly as possible. If haste is an element of importance in a particular operation, time may be saved by calling upon an extra assistant; but if haste is not essential to the immediate or ultimate result of the operation, and the latter can be carried out in every detail equally well without his services, the extra assistant should not be employed. The number of assistants, again, will vary according to whether it is the surgeon's custom to have the nurse or an assistant regularly engaged for passing the ligatures and sutures. Assuming that an assistant handles the ligatures and sutures, more than three assistants should not be required. The first assistant is present at all operations, and is the operator's right-hand man; in addition to handing the instruments, he assists the operator in every possible

way in the performance of his task ; the second assistant is called upon when the occasion demands. Thus in all laparotomies, and in all operations in which the edges of the wound must be retracted, he is indispensable ; the third assistant has charge of the ligatures, sutures, and needles. The clinic nurse is present, wearing a sterilized apron or a sterile suit, and disinfects her hands immediately before the operation. Her duties consist chiefly in taking charge of all the solutions that may be required for irrigation or other purposes ; if hypodermoclysis is needed, she makes the necessary preparations. If special solutions are required in emergencies, she is on hand to supply them ; if instruments drop upon the floor, or if additional instruments are wanted, it is her duty to sterilize them. In short, if during the course of an operation any emergencies arise which have not been provided for, or if objects must be handled which have not been sterilized, the nurse gives these matters her attention.

When due preparation has been made for an operation it is assumed that everything that may be required is sterile. The dressings, sponges and pads, aprons, sheets, and towels are in the autoclave ; the agateware utensils have not been removed from the boiler where they have just been sterilized ; the instruments have just been boiled and are still in the instrument-sterilizer. The operating-table is in its proper place ; on one side is a small table for the dressings, ligatures, and sutures ; on the other side is a table for the instruments. An extra table is at hand upon which to place basins of solutions for the operator's hands. The immediate preparation for the operation is carried on as follows : (1) The nurse removes the cage from the autoclave, places it upon a table, unpins the sheet in which the cage has been wrapped, and folds it back. (2) The third assistant covers the small tables with sterile sheets taken directly from the cage, and hands as many sheets or towels to the first assistant as he may require to cover the patient. (3) The third assistant removes from the sterilizer the necessary trays, basins, and pitchers, and places them upon the small tables already covered with sterile sheets. (Not more than two round basins, one kidney-shaped basin, and two pitchers will be required.) As soon as the patient is transferred to the operating-table the nurse removes the temporary dressing, and the first assistant begins to prepare the field of operation. The solutions he requires may be poured by the nurse in sterile basins, or may be poured by her directly upon the patient's skin from sterile flasks. (4) The instruments are transferred in the wire cage from the sterilizer to the trays and covered with sterile water, or a 1 per cent. sodium carbonate solution. Thus in a few minutes everything is in readiness for the operation, and each solitary object is as sterile as human invention can make it.

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The anæsthetizer should not commence to administer the anæsthetic before the surgeon and his staff are ready to begin the disinfection of their hands. Fifteen minutes at least should be allowed for this procedure, a period of time which in the average case is more than will be required to fully anæsthetize the patient. If the anæsthetizer starts too soon, the patient will be ready for operation before the surgeon, while the latter must either keep the patient waiting or curtail the time requisite for proper hand-disinfection. The operation begins (Fig. 31) with the chief standing upon the side of the table that

FIG. 31.



Operation in progress, showing arrangement of tables and relative positions of operator, assistants, and nurse.

best suits his convenience, the first assistant directly opposite; the second, if there be one, on the same side of the table as the operator, and the third assistant or nurse at the dressing-table within the surgeon's reach. The instruments when needed are handed to the operator by his first assistant, and the gauze sponges supplied by the third assistant or the nurse. During the course of an aseptic operation no solutions are required, as a rule, unless at the end of the operation, when it may be deemed advisable to flush the wound with a sterile or normal salt solution. The latter is, theoretically at least, the more bland and non-irritating of the two, because it is isotonic or of osmotic indifference, and for that reason is to be preferred to any other. The tissues should always, more especially during prolonged operations, be protected from exposure and subjected to the least traumatism possible. Thus in extensive dissections, when large areas of tissues are exposed, as much of these as possible should be

covered with sterile towels or pads, to prevent chilling of the part; the tissues should always be handled as gently as possible, and the dissection carried on with the edge rather than the handle of the knife. Blunt dissection causes a degree of traumatism that is most objectionable. For the same reason it is advisable to interpose a gauze pad between the tissues and blade of the retractor. It is only by paying the strictest attention to these details, which individually seem relatively unimportant, that the best results can be hoped for. The avoidance of traumatism and of irritating solutions and perfect hemostasis do more toward preventing infection and securing union by first intention than any other factors.

From time to time during the operation the gloves and instruments should be rinsed off in order to remove fragments of tissue or clots of blood, upon which particles of dust may have settled. When not in use the instruments should be laid in the instrument-tray rather than on the table or patient. The skin about the incision should be kept covered with sterile towels or sheets, in order to eliminate as far as possible this possible source of contamination; and the towels as soon as they become soiled should be removed and clean ones substituted. Upon the completion of the operation, after protecting the wound itself with sponges or pads, the skin in the neighborhood of the wound should be cleansed, allowing no fragments of tissue or clots of blood, which furnish suitable soil for bacteria, to remain. At no time should the same sponge be used in the wound which was used in cleansing the skin. The dressing should be large enough to include an area wide of the wound, and thick enough to absorb the subsequent oozing. It should be applied firmly, not only to insure rest of the parts, but also to avoid the necessity for re-dressing until repair has taken place. The patient should at all times be subjected to as little exposure as possible. Exposure may be avoided by having the parts which are not in the immediate neighborhood of the seat of operation covered with blankets. If the operation is a prolonged one, the degree of shock may be moderated if the patient lies on an electric mat, or if hot-water cans are kept applied to the trunk or extremities.

The *treatment of aseptic wounds* necessitates the avoidance of those conditions which favor the growth or development of microorganisms, and these conditions are recognized as being the presence of blood-clots or serum, the existence of dead spaces, the presence in the wound of fragments of tissue imperfectly nourished, and, finally, imperfect drainage.

#### TREATMENT OF ASEPTIC WOUNDS.

**Hæmostasis.**—Since blood and serum furnish such perfect soil for the cultivation of bacteria, no pains should be spared to secure as

dry a wound as possible. While the blood is believed to have distinct bactericidal properties, which are attributed chiefly to the phagocytic action of the leucocytes, these properties are not manifest in blood which is no longer in circulation. Hæmostasis is best secured by ligation of all bleeding points, and catgut is the best ligature-material. In many wounds, especially those in inflammatory tissue, the bleeding points will be so numerous and involve so large an area of the wound that it may be impossible to obtain a perfectly dry wound; and even were it possible, one can readily understand how in some cases it might be unjustifiable to prolong the operation sufficiently to secure every bleeding point. Then, again, the presence of so many pieces of constricted tissue, which eventually becomes necrotic, predisposes to infection. No time should be lost in grasping a vessel, no matter how small, once it has been severed, in order to prevent the loss of much blood during the operation; and, what is equally important, in order to give the operator a dry and clear field in which to carry on his dissection. When the wound becomes uncomfortably crowded with hæmostatic forceps ligatures should be applied and the forceps removed. In picking up bleeding points with hæmostatic forceps one should include as little tissue as possible, and the ligature when applied should be cut quite close to the knot; one wants to leave in the wound as little foreign matter as possible, for each particle, if not absorbed, may become a focus of suppuration. It must, therefore, be left to the judgment of the operator whether it is justifiable to attempt to ligate every bleeding point. When hemorrhage consists in general oozing, this is often controlled by exposure for a few minutes to the air or by douching the wound with a hot solution, which through its action upon the vasomotors stimulates contraction of the vessel-walls.

**Drainage.**—During the pre-antiseptic period, and even in the period of antiseptics, drainage was resorted to with great regularity owing to the frequency with which infection followed accidents and operations. When after the introduction of asepsis infection occurred with relative infrequency, drainage was very generally discarded in the post-treatment of wounds; but later on, when surgeons began to understand the principles involved in combating infection, a reaction set in, as a result of which to-day, even after aseptic operations, the practice of introducing drainage has again become popular.

At the termination of the operation the operator must, upon inspection of the wound, determine whether it will be necessary to resort to drainage. He will be influenced in making his decision by a consideration of the following points: the presence or absence of perfect hæmostasis, the extent of the wound, the possibility in closing the wound to bring the parts in perfect apposition and to oblit-



erate all the dead spaces, the practicability of exerting firm pressure upon the wound after the dressing has been applied. If at the close of the operation there is more or less oozing, drainage should be introduced without question. In every wound a certain amount of serum exudes from the tissues, and in very extensive wounds this amount of serum is large enough to be taken into consideration, so that even when, at the termination of the operation, the wound seems comparatively dry, it is good practice to introduce drainage. Then, again, it should be borne in mind that when the circulation is depressed by shock, at the close of the operation, there may be no bleeding, even though the divided vessels have not been ligated. As soon as reaction is established, however, hemorrhage from these points may be quite free. The second factor to be considered is the possibility of obliterating all the "dead spaces," areas in which serum and blood may accumulate. There are certain operations, as in laparotomies, in which, by closing the wound layer by layer, we can effect perfect apposition of all structures and leave no areas which may serve as reservoirs for escaping blood and serum; there are others, too, in which it is possible to exert sufficient pressure to insure obliteration of these spaces, and in such instances drainage is not positively indicated. But when, as in an amputation of the breast, entailing a deep dissection in the axilla, it is impossible to close the wound in the ideal way, drainage should be employed. In general, it may be said that in all cases of doubt it is better practice to err on the side of prudence and introduce drainage.

Strips of gutta-percha tissue, India-rubber tubing, glass tubes, strands of horsehair or silkworm-gut, and strips of gauze will meet all the indications. In the average case one or more narrow strips of gutta-percha tissue or a few strands of silkworm-gut will, if properly introduced, suffice to drain the blood or serum from the depth of the wound to the overlying dressing. They should be introduced at the most dependent portion and carried down to the very depth of the wound. When there is a possibility of considerable oozing, drainage is best effected by rubber tubing fenestrated at proper intervals. In aseptic cases drainage may be dispensed with at the end of twenty-four to forty-eight hours, at which time hemorrhage will have been controlled by the formation of clots. Were it not for the fact that it has served its purpose within this time, drainage would not be so strongly recommended in the treatment of aseptic wounds. If allowed to remain longer, a sinus might form along the drainage-track which would interfere with union by first intention; the drainage-material might serve as a channel of communication between the cutaneous surface and the depth of the wound, by which organisms present in the layers of the skin might reach and infect



the deeper layers of the wound. The necessity of having to disturb the dressing before union has taken place might well constitute another objection, were it not that the dressing can be so applied as to make it possible to remove the drainage without exposing the wound. (Fig. 32 shows a stump with the deep dressing *in situ* secured

FIG. 32.



Amputation of lower third of thigh. Primary dressing applied in such a way that the drainage-tube can be removed without exposing wound.

in place with a bandage; the drainage-tube which was introduced at the time of the operation can be removed in the next twenty-four to forty-eight hours without disturbing the deep dressing.)

Glass tubing is to be preferred to rubber tubing when there is danger of the walls of the latter collapsing. Glass tubes are used almost entirely after operations upon the peritoneal cavity when it is desirable to drain off the fluids accumulating in the pelvis. Capillary may be combined with tubular drainage by passing strips of gauze through the lumen of the tube; or an improvised tube may be made by wrapping a piece of rubber tissue around one or more strips of gauze.

Sufficient has already been said to emphasize the desirability of securing perfect coaptation of the parts; and, realizing this, surgeons have devoted no little time to the concluding steps of the operation. When the incision has extended through several layers of tissue, more perfect approximation and approximation under less tension can be effected if the wound be closed layer by layer. Thus after an operation for the removal of an appendix the peritoneum and transversalis fascia constitute one layer, the internal oblique with its sheath another, the aponeurosis of the external oblique the third, and the skin and subcutaneous tissue the fourth.

While it is expedient that all cavities and dead spaces be obliterated, this must not be done at the risk of subjecting the tissues to too great tension, thus lowering their vitality to such extent as to predispose to infection and interfere with repair. The material to be used differs according to whether the suture is a buried or a superficial one; for buried sutures catgut is to be preferred for the same reasons that it is preferred as a ligature-material. Some surgeons prefer to use silk or silver wire, on the ground that they are more easily sterilized and give better support to the parts during the process of repair. If the catgut sutures are properly introduced and the knots securely tied, they will afford ample support for any wound. The presence of an unabsorbable and therefore permanent buried suture adds no additional strength to the part, for this depends wholly upon whether or not union of the deeper layer has been perfect.

If for any reason it is impossible to close the deep layers of the wound with buried sutures, silkworm-gut sutures, introduced from a half to one inch from the margin of the wound, and through its entire thickness, must be used instead; and they should be introduced with a view to bring into apposition the deep rather than the cutaneous layer. The skin-edges themselves may afterward be brought into more perfect apposition by interrupted silk sutures introduced about one-half inch apart, and from a quarter to half an inch from the margin of the wound.

There are certain occasions when it may be undesirable to close the wound immediately. In operations performed in the neighborhood of an infected area it is difficult to determine positively whether or not the tissues at the seat of operation are infected. In cases of doubt it is an excellent plan to postpone closing the wound until assured that it is not infected. At the completion of the operation provisional sutures should be introduced, but not tied, and the whole wound packed with sterile or iodoform gauze. If at the expiration of twenty-four or forty-eight hours there is reason to believe that the wound is not infected, the packing can be removed and the surfaces of the wound approximated by the provisional sutures.

#### DRESSING OF ASEPTIC WOUNDS.

Whether the wounds are accidental or operative the subsequent treatment is the same provided they are aseptic. The dressings should be thick enough to absorb the discharges, and large enough to cover an area wide of the wound. There is no better material for dressing than sterile gauze and absorbent cotton; the antiseptic dressings are not so absorbent, and have little, if any, influence over the growth of such pyogenic organisms as may penetrate them. The dressing should be applied with a view to exerting even and moderate

pressure over the entire wound. This has a twofold purpose: first, to control oozing; secondly, to obliterate any dead spaces that may remain. The bandage should not be unnecessarily tight, and yet it must be tight enough to prevent the dressing slipping and to keep the part at rest. It is most important that the tissues be kept at rest while they are undergoing repair, and to accomplish this it is necessary to enjoin the patient to keep quiet. To this end strips of adhesive plaster, splints, plaster-of-Paris bandages, and other fixation dressings are employed to advantage. After laparotomies broad strips of adhesive plaster, fortified by a binder, will not only prevent the dressing slipping, but also protect the wound from muscular traction. After the radical cure for hernia a plaster-of-Paris bandage including the upper half of the thigh and pelvis will keep the parts at rest. Plaster-of-Paris or splints may be used to advantage after operations or wounds in the neighborhood of joints. After amputations of the breast the arm is bandaged to the side in order to prevent traction upon the wound by the remaining fibres of the pectoral muscles. After operations upon the cervical region the space between the under surface of the chin and the sternum should be filled with gauze and cotton, in order to prevent flexion of the head and neck. The dressing may be fortified by a collar or stock of binders' board; sand bags may be placed on either side of the patient's head to prevent rotation. In all cases after the dressings have been applied it is much better to apply two or three bandages with a moderate degree of firmness than one too tight. A few strips of adhesive plaster are put on to make the dressing more secure. The question is asked, How soon and how often should a wound be dressed after an aseptic operation? If the dressing has not become saturated through and through with blood or serum, and if the wound has not been drained, the dressing should not be disturbed until it is time to remove the stitches. Nothing is to be gained by meddling with dressing, and certain risks are incurred. According to the depth of the wound and the nature of the tissues, the time to remove the stitches varies between the first and second week, and by this time the wound will have united sufficiently to eliminate the possibility of infection at the change of dressings. It is not necessary to use antiseptic solutions in dressing aseptic wounds. After the stitches have been removed the skin should be washed with alcohol and a light protective dressing applied. The indications for changing the dressing earlier than this may be said to be three: (1) when the dressing is saturated with blood or serum; (2) when drainage has been introduced; (3) when there are signs pointing to infection.

(1) Immediately after the operation it is the nurse's duty to watch for and report any oozing, which, if it occurs at all, will usually make



itself manifest within the first thirty-six hours. The dressing should not, in such an emergency, be removed unless it is thoroughly saturated; and even then it is not prudent to remove that portion of it in immediate contact with the wound. Ordinarily it will suffice to reinforce the original dressing. (2) Drainage in aseptic wounds will have served its purpose within the first twenty-four to forty-eight hours, at the end of which time it should be removed with the strictest aseptic precautions. With sterile instruments and towels, and with properly disinfected hands, the attendant surgeon proceeds to withdraw the drainage-material. To do so, it will not be necessary for him to handle the wound; and if the first dressing be applied in the manner above suggested (Fig. 14) the wound itself need not be exposed. The tissues should be subjected to as little disturbance as possible; the parts should not be roughly handled, or even handled at all. The drainage is removed with a pair of forceps and a sterile dressing at once applied. If these directions are carried out, the dressings may be changed with impunity. The question of irrigation with either sterile or antiseptic solutions has been purposely omitted, because its consideration in the after-treatment of aseptic wounds is out of place. (3) Infection has been mentioned as one of the indications for a change of dressing, although, strictly speaking, it should not enter into the discussion of the treatment of aseptic wounds. One should be familiar, however, with the course of a traumatic or aseptic fever that accompanies the process of repair in wounds. Immediately after an operation or injury of any gravity the temperature falls below normal, and as the stage of reaction sets in the temperature begins to rise, and within twenty-four hours will register between 100° and 102° F. The patient at this time may complain of slight hebetude, the tongue will be coated, and the bowels inactive. During the next twenty-four hours the temperature will begin to fall, so that at the end of the second or third day it will have reached normal. An action of the bowels has followed the administration of a laxative or enema, the headache has disappeared, and the tongue cleared off. Such a train of symptoms is to be looked for after the infliction of any wound. If the latter had been infected at the time of operation, the signs of infection would begin to make themselves manifest just about the time the aseptic fever was subsiding. Between the second and fourth day the temperature, instead of returning toward normal, rises a degree or two higher than it had previously been, and the patient complains of feeling chilly or has a pronounced chill. He complains of a throbbing sensation in the wound, which feels, too, as though it were under great tension. The following day the condition is aggravated. Such a train of symptoms points to infection, and the surgeon should then not hesitate to remove the dressing and examine the wound.



## TREATMENT OF SEPTIC WOUNDS.

The principles that govern the treatment of septic wounds must take into consideration the means at Nature's command to combat infection. A method, the efficiency of which is wholly dependent upon the uncertain bactericidal properties of chemical antiseptics, is, to say the least, irrational, and will meet with only moderate success. When pyogenic organisms invade tissues Nature immediately makes heroic efforts, first, to prevent the spread of the infection from the original focus; secondly, to counteract the effects of the products elaborated by those organisms; thirdly, to expel the organisms and their products; and, lastly, to repair the damage inflicted upon the tissues. The appearance of bacteria is the signal for a furious outpouring of leucocytes, which make an aggressive attack upon the invading organisms. The means at their command are threefold: first, in the rôle of a phagocyte the leucocyte actually destroys the pus-organisms; secondly, the products elaborated by the leucocyte have an inhibitive effect upon the growth of these organisms; thirdly, the dense wall that has been formed by the round-cell infiltration not only protects the surrounding tissue, but also cuts off the blood-supply from the infected area and deprives the bacteria of pabulum so necessary for their existence. Should the infectious material escape from the original focus through the channels of the lymphatic vessels, the lymphatic glands stationed as barriers guard against further invasion. Thus the tissues, by means of a very definite and well-conceived plan, carried out by the vascular system, are able alone to cope successfully with infection.

The physician in his treatment of infection or inflammation must not discount the ability of the human system to take care of itself, and must always cooperate with and never antagonize the plans which Nature has adopted.

The degree of infection depends upon two factors, the virulence of the organism and the power of resistance on the part of the patient; the degree of local or systemic disturbance will be in direct proportion to the relation those two factors bear one to the other. This being the case, the course for the physician to pursue is clearly laid out, first, he must use every means at his command to lessen the virulence of the organisms, provided it does not destroy the vitality of the tissues; secondly, he must aid Nature in ridding herself of the organisms and their products without in any way lessening her resistance power. Such a course of treatment includes the judicious use of antiseptics, the introduction of drainage, employment of irrigation, the more or less frequent change of dressings, and the internal administration of stimulants.

**The Use of Antiseptic Solutions.**—The value of antiseptic methods in the treatment of wounds already infected cannot be too highly estimated; and yet, at the same time, there is great danger of these methods being so abused and so misapplied that they may result in more harm than good. According to the strength of the solution will the drug have an inhibitive or bactericidal effect upon the organisms. Were it not for the fact that these chemical disinfectants have a distinctly deleterious effect upon the tissues, it would be an easy matter to decide how strong a solution should be used; but when it is known that a solution of corrosive sublimate as weak as 1 : 10,000 will produce a superficial slough upon wound surfaces the problem becomes a perplexing one. The bactericidal value of all disinfectants has been based upon investigations which did not take into consideration their effect upon the human tissues, and are therefore of little practical value. Those experiments that have been made upon animals are not to be relied upon, because of the fact that animals, as compared to human beings, are not nearly so susceptible to infection with pyogenic organisms. In the long run, I believe better results will be obtained by relying upon the inhibitive property of an antiseptic solution, with the hope of holding the organisms in abeyance until the tissues have reacted sufficiently to guard against further invasion. A solution which has an inhibitive effect is many times weaker than one of bactericidal strength, and its effect upon the tissues is correspondingly less damaging. It would be better practice to irrigate a wound several times in the twenty-four hours with a bland solution than once with a concentrated one. The rationale of this is easily seen: irrigation of a wound with a concentrated solution has a decidedly depressant effect upon the tissues; and while it may destroy those organisms with which it comes in contact, it fails to influence many of those organisms deeply seated in the tissues. The situation may be summed up as follows: (1) Strong solutions (1 : 1000), while bactericidal, are likewise irritant and sometimes poisonous; they kill the organism, lessen or altogether inhibit tissue-resistance, and cause at times symptoms of poisoning. (2) Weaker solutions (from 1 : 10,000 to 1 : 4000) inhibit the growth of organisms; have but a slight, if any, depressant effect upon the tissues; are not liable to poison the system.

Infected wounds may be exposed to the influence of antiseptic solutions at stated intervals by means of irrigation, or continuously by means of irrigation and wet dressings.

I. Irrigation at stated intervals:

1. When the infection is localized.
  2. When the wound can be properly drained.
-

3. When there is little evidence of absorption of the infectious material.
4. When the wound-secretions are not excessive.

## II. Continuous irrigation :

1. When there is a tendency for the infection to spread.
2. When the wound is not spontaneously evacuated by drainage.
3. When there are signs of marked systemic disturbance from absorption.
4. When the discharge is so profuse that the dressing cannot absorb it.
5. When the infection is highly virulent.

## III. Antiseptic fomentations :

When there is a diffuse cellulitis around the wound.

I. IRRIGATION AT STATED INTERVALS.—In cases of mild infection when the wound is not very large and the purulent discharge not very profuse, irrigation should be practised but once a day. The wound should first be irrigated with peroxide of hydrogen until there is no further reaction, and then with a solution of corrosive sublimate not stronger than 1:4000. When, after days of such treatment, the granulation-tissue looks sluggish and indolent, and there seems to be little or no effort at repair, it would be well, providing, of course, the infection is under control, to discontinue altogether the antiseptic solution. The wound may be mechanically flushed with sterile water, and its surfaces stimulated with silver nitrate or balsam of Peru. It is well to remember that the good effects following wound irrigation are not altogether due to the virtue of the antiseptic, but in a measure to the mechanical removal of the inflammatory products that have accumulated in the wound.

When the wound is extensive and the purulent discharge very profuse irrigation may be practised with good effect two or three times during the twenty-four hours.

II. CONTINUOUS IRRIGATION is to be reserved, as has been pointed out, for those cases in which the discharge is so profuse or the dressings so imperfect that the wound-surfaces are constantly bathed in purulent discharge, when there is evidence of marked systemic disturbance, and when the infection is a virulent one and spreading beyond the immediate surroundings of the wound. Such cases as these may follow either accidental or operative wounds, and require prompt attention. For continuous irrigation the solutions should be warm, since the continuous application of cold solutions will have a depressant effect upon the tissues.

A solution of corrosive sublimate is the most efficient for the purpose, and should not be stronger than 1:10,000. If the wound be on an extremity, the latter should be elevated on an inclined plane, and



the bed-clothes and patient protected by a mackintosh, which drains the solution directly into a receptacle at the side of the bed. The solution conveyed from the jar by siphoning through a tube, or by capillary drainage through a piece of gauze, is allowed to trickle over the wound. The patient may be kept perfectly dry if an apparatus such as that illustrated in Fig. 33 be used. In infected wounds in

FIG. 33.



Continuous irrigation. Irrigating fluid carried into receiver at foot of table. Patient kept perfectly dry.

the abdominal wall an extra tube may be employed to carry off by siphonage the wound-secretions and irrigating fluid. Just as soon as the infection seems to be under control continuous irrigation should be discontinued.

*Permanent baths* may be used to advantage, and under certain circumstances are to be preferred to continuous irrigation. They are of particular value in cases in which continuous irrigation is imprac-



the bladder the permanent bath has been found to drain the bladder thoroughly as materially to lessen the chance of infection. The permanent bath can be used to good effect, too, in infected wounds of the foot or hand, particularly those in which the infection has extended to the arm and leg, and has required multiple incisions to relieve tension and allow for the escape of infectious material.

II. ANTISEPTIC FOMENTATIONS seem to exert some beneficial influence upon infections involving the subcutaneous cellular tissues. When the process of inflammation has reached the stage of suppuration, when there are no abscess-cavities which may be opened by incision, the application of cloths or layers of gauze wrung out in a 1 : 10,000 solution of corrosive sublimate seems in many cases to exert a favorable influence on the inflammatory process. Just how much good results from the merits of the antiseptic, and how much from the effect of the warmth and moisture, it is difficult to say.

Drainage.—There is no phase of the treatment of infected wounds which demands more attention than that of drainage. No matter how shallowly or how persistently a wound is irrigated, the infection will be difficult to control unless proper drainage is provided. More should be done to assist Nature in her efforts to control infection by establishing thorough drainage than by other means. The pus which is formed in the last stage of the process of inflammation represents the destruction of so many organisms on the part of the body, and just as fast as pus is generated just so fast should provision be made for its immediate evacuation.

Drainage may be either tubular or capillary.

TUBULAR DRAINAGE is more suited to extensive wounds with a severe purulent discharge. For this purpose flexible rubber tubing should be secured in sizes from one-eighth inch in diameter upwards. Before being introduced it should be fenestrated at various points, the size of the openings being about one-third the diameter of the tube. When the wound is a deep one and drainage is not

any foreign body, and when this becomes organized the track of the tube may persist for some time. In draining large cavities which it is desirable to irrigate, two tubes may be used instead of one—one tube serving as the inlet and the other as the outlet for the irrigating fluid. When a tube is put in at the close of an operation it may be secured in place by suturing it to the skin; but this method is only recommended when there is danger of the tube slipping into a cavity from which it would be difficult to extract it, as, for example, in drainage of the pleural cavity. Ordinarily the tube may be prevented slipping into the wound-cavity by inserting a safety-pin in the outer end. As the cavity grows smaller the drainage-tube should be shortened; it should always be cut off so that the end is flush with the surface of the wound, and should not project beyond. If it does, the weight of the dressing may flex the protruding portion and so occlude its lumen as to interrupt drainage, or may force the other end against the wall of the cavity, where it would serve as a source of constant irritation.

In the treatment of accidental wounds, or when operating in the neighborhood of infected areas, if there be any doubt as to the sterility of the wound, it is well to insert a drainage-tube at the first dressing, with the hope of being able to withdraw it within twenty-four or forty-eight hours, if the wound should prove to have escaped infection. After all injuries in which the tissues about the wound have been subjected to much traumatism some form of drainage should be provided, anticipating, if not infection, at least some sloughing.

CAPILLARY DRAINAGE.—According to the character and the amount of wound-secretion must one decide as to which of the two methods of drainage is best suited to the case. When the wound is not extensive, and when the discharge is not very thick or very profuse, a strip of gauze properly introduced will answer the purpose. When introducing gauze the wound should not be plugged so tightly that the pus cannot escape. The end of the gauze strips should first be carried down to the deepest portion of the wound, and the remainder gently packed in over it in order to form a continuous route from the depth to the mouth of the wound.

Under certain conditions it may be inadvisable to attempt to close any part of the wound, and under such circumstances the entire wound-cavity is plugged with gauze in such a way as to keep the edges apart. After operative or accidental wounds the oozing may be uncontrollable or the tissues either known to be or suspected of being infected. If at the end of forty-eight hours the hemorrhage has been controlled and there is no evidence of infection, the gauze may be removed and the wound closed throughout. Such a plan will,

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if adopted, save considerable time, for the wound, instead of healing slowly by granulation, will unite by second intention. Iodoform gauze is better suited for these dressings than sterile gauze, as in the event of the wound becoming infected the iodoform will disinfect the purulent discharge.

**Dressings.**—After the application of the first dressing the question will arise as to how soon the wound should be re-dressed. In doubtful cases, when it is uncertain whether or not the wound is infected, the temperature offers a very useful guide. For the first forty-eight hours, even in septic wounds, there will be more or less fever according to the degree of traumatism and the extent of the wound. This is nothing more nor less than traumatic, or aseptic, fever, in which the temperature reaches its highest point during the first forty-eight hours, and returns to normal by lysis. If at this time the fever does not decline, but continues with fluctuations, one's suspicion should be at once aroused and the wound re-dressed. If the wound then be found to be the seat of infection, the dressing must be changed daily or on alternate days. The frequency with which dressings should be changed depends altogether upon the amount of discharge from the wound and upon the necessity of irrigating the wound. If the dressing be large enough to absorb the secretions of twenty-four hours, daily dressings will be sufficient, and as the inflammatory process subsides the frequency of the dressings may be gradually reduced.

The second indication for re-dressing a wound is the necessity for irrigation, the indications for which have been pointed out.

**WET AND DRY DRESSINGS.**—Dressings saturated with a 1:100 solution of carbolic acid or with a 1:4000 solution of corrosive sublimate are preferable to dry dressings in large open wounds, when not only the wound-surfaces, but also the tissues surrounding the wound are infected. The surfaces of the wound may be infected, and yet the drainage be so perfect and the resistance of the tissues so vigorous that there is no tendency for the infection to spread to the surrounding tissues. In such cases the wound may be packed with iodoform gauze and a dry sterile dressing applied. (Dry antiseptic dressings are not so absorbent as sterile gauze, and do not contain enough of the chemicals with which they are prepared to inhibit germ-growth.) When, on the other hand, the appearance of the surrounding tissues leads one to believe that the inflammatory process is extending from the original site of the infection, some measures should be adopted to check its progress. In addition to frequent irrigation, the wound should be kept constantly exposed to some germicide; and to do this the dressing must be saturated with some antiseptic solution. The good results that follow the use of wet dressings when applied to areas in which the inflammatory process

involves only the skin and cellular tissue must be ascribed to absorption through the skin of a certain amount of the disinfectant. A very efficacious dressing for cellulitis is one saturated with a solution of carbolic acid (1 : 100), in which the dilution is made with 50 parts of alcohol and 50 parts of lead-water and laudanum. This combines the merits of an analgesic, an evaporating, and an antiseptic lotion. With this the gauze is saturated, and secured in place with a gauze bandage, so that as the solution evaporates more may be added without removing the dressing. Waxed paper or oiled silk should not be used, as they interfere with evaporation and eliminate one of the merits of the dressing.

#### CONSTITUTIONAL TREATMENT.

There is no specific in the treatment of the constitutional manifestations of infection, with the exception of those infections by the tetanus bacillus or the streptococcus. After all has been done to control the local manifestation such remedies should be administered as will support the patient and favor elimination of the organisms themselves, or such of their toxic products as may have gained entrance to the circulation. A highly nutritious and easily assimilated diet, liberal quantities of alcoholic stimulants (preferably whiskey), together with strychnine, form the basis of such a form of treatment. The bowels, the kidneys, and the skin should be kept active, as through these canals the toxic products are eliminated. To this end diuretics and laxatives should be given, if necessary, to insure the elimination of a liberal amount of urine and a daily evacuation of the bowel. Normal salt solution, introduced either by hypodermoclysis or directly into the veins, has been regarded as a valuable adjuvant in the treatment of grave constitutional symptoms of infectious origin, and the improvement following its administration justifies one in entertaining such an opinion. The introduction into the circulation of a pint or a quart of a normal salt solution exerts a favorable influence in one of several ways: first, it acts as a diluent, diluting the poison circulating in the blood; secondly, it increases the quantity of urine secreted by the kidneys, thereby favoring the elimination of a certain amount of the toxins; thirdly, it increases the amount secreted by the skin; fourthly, it has been found that massive saline injections reduce the leucocytosis of infection much more than can be accounted for by the temporary dilution of the blood, and that this, in all probability, must have been due to reduction of the toxæmia; lastly, the experiments upon the effects of intravenous saline injections after severe hemorrhage may, by analogy, throw some light upon the action of such injections in conditions of toxæmia. Just as in the former instance proteids and sugar are brought out of the tissues

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into the circulation, so would the toxic products, which would then be placed under circumstances more favorable to excretion.

A quart of normal salt solution at a temperature of 105° F. may be introduced once or twice a day, according to the severity of the case, into the cellular tissues or directly into the veins.

**Serotherapy.**—This form of treatment has so far only been applied to tetanus and streptococcic infections, and the results are not, on the whole, encouraging.

**ANTISTREPTOCOCCIC SERUM** has been employed in the treatment of erysipelas, pyæmia, osteomyelitis, and puerperal fever. But only in the first and the last mentioned affections has its trial been extensive enough to enable any conclusions to be drawn, and in these cases the reduction of the mortality is so small as to fall within limits of variation in the mortality of any two series of cases. The more positive results obtained in laboratory investigations justify its further trial, and it may be that with additional clinical experience better results will in time be obtained. If used at all, it should be given only as an adjuvant to the other remedies, in doses of from 10 to 25 c.c., and early in the course of the disease. If administered late in the course of the infection, there is reason to believe that it is less efficacious.

**ANTITETANIC SERUM.**—Regarding the treatment of tetanus by its antitoxin, the outlook seems somewhat more favorable, at least in the subacute and chronic cases. The acute cases, in which the mortality is the highest, have been practically uninfluenced by the serum. The latter may be administered in one of three ways: hypodermically, as an intravenous or an intracerebral injection.

Clinical experience has proved that good results depend altogether upon the administration of maximum doses. Not less than 500 units should be administered as an initial dose hypodermically or directly into the veins, and from 250 to 500 c.c. on successive days until the symptoms begin to abate. The intravenous method is to be preferred, since it insures the immediate introduction into the circulation of the whole dose. The serum before being introduced should be heated to a temperature of 102° F. The intracerebral injection of antitetanic serum promises better results. For this purpose the skull is trephined on either side of the median line, and from 4 to 6 c.c. of serum injected into the right and left lateral sinus on alternate days.



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## FRACTURES.

**Fracture** is the solution of continuity or the breaking of a cartilage. It is one of the most common surgical conditions, at the same time one which demands the utmost care and attention in diagnosis and treatment, to secure a result satisfactory to the patient and the physician. While it is not within the scope of this article to enter minutely into the details of pathology and treatment, these points will be elucidated as far as is necessary for a proper understanding of the therapeutic measures to be em-

**Causes of Fracture.**—The causes of fracture are divided into *disposing* and *exciting*.

*Disposing* causes, we have the position of the bones, and the structure, normal factors always present. Thus, the bones of the extremities are more liable to injury than those of the trunk. Long, thin bones are more liable than short, thick, or irregular ones. Bones of elastic structure break easier than those of brittle structure. There are also pathological conditions which predispose to fracture by affecting the nutrition of the bone or by directly attacking it. These include rheumatism, diabetes, certain nervous affections (such as locomotor ataxia), and sarcoma; necrosis and caries also predispose to fracture. Also certain obscure diseases affecting the bones, the pathology of which is not well understood, as *fragilitas ossium* and *osteomalacia*.

*Exciting*, or *causes of fracture* are external violence or internal action. The first is the usual cause of fractures, as seen in those due to blows, falls, crushing injuries, etc. Muscular action as a cause of fracture is seen most commonly in the case of the ribs, much more rarely in the case of the sternum, ribs

etc. A broad, important, primary classification is into simple, or closed, and compound, or open. *Simple*, or *closed*, fractures are those in which the seat of fracture does not communicate with the air through a wound in the soft parts. *Compound*, or *open*, fractures include those in which such a communication exists, and are due to injury of the soft parts covering the bone, the communication with the air being established either by the injury which produces the fracture or by the ends of the bones subsequently penetrating the tissues. The surgeon sometimes purposely converts simple into compound fractures for therapeutic purposes.

Fractures are classified by their degree into *complete* and *incomplete*. A *complete* fracture is one in which the bone is broken entirely through; an *incomplete*, or *green-stick*, fracture (Fig. 34) is one in which the bone is bent and partially broken, some of the fibres not giving way. The latter variety is common in the soft bones of children, and it is often necessary to convert it into a complete fracture to secure perfect correction of the deformity.

The term *single* fracture explains itself. A *multiple* fracture is one in which the same bone is broken in more than one place, the

FIG. 36.



FIG. 34.



FIG. 35.



Partial, or green-stick, fracture of the radius.

Comminuted fracture of the patella.

Multiple fracture of the tibia and fibula. (Dennis.)

lines of fracture being distinct and not communicating (Fig. 36). Where there are several communicating lines of fracture (Fig. 35), resulting in the formation of several fragments, we speak of a *comminuted* fracture.

Fractures are classified by their shape and direction into fissured, stellate, punctured, depressed, transverse, dentate, spiral, oblique,



and longitudinal. *Fissured* fractures, seen in the skull and flat bones, show one or more lines of separation, the fracture being incomplete. A *stellate* fracture is one in which the lines radiate from one point. A *punctured* fracture is one in which the bone is penetrated by a pointed instrument or a bullet; it is often comminuted. A *depressed* fracture is one in which a portion of the bone is driven below the surface of the remainder, as is seen on the surface of the skull and other flat bones. The remaining terms are self-explanatory.

An *impacted* fracture is one in which one fragment has been firmly driven or wedged into the other (Fig. 37).

A *sprain-fracture* consists in the detachment or tearing off of a ligament or tendon with a small portion of the bone to which it is attached.

*Epiphyseal separation* takes place at the junction of the diaphysis and epiphysis in childhood before the epiphyseal cartilage has been replaced by bone, and is due to the same causes as fracture, of which it is really a form.

A *complicated* fracture is one in which to the injury of the bone is added some injury to some of the neighboring structures, such as a dislocation of a neighboring joint, the rupture of large bloodvessels, nerves, or muscles, a wound of the soft parts, etc.

**Symptoms of Fractures.**—Fractures are accompanied by a number of symptoms, objective and subjective, not all of which may be present in every case. The symptoms are deformity, mobility, crepitus, loss of function, pain, and muscular spasm. The first three symptoms—deformity, mobility, and crepitus—are objective, and are the most important.

**Deformity.**—This is due to a change in the relations of the fragments of the fractured bone, and also to swelling of the part, due to extravasation of blood and serum; and later, of exudate and callus. It is usually quite a striking symptom in the case of the long bones when the fracture is complete. It may be altogether absent under certain circumstances. Displacement of the fragments is due either to the fracturing force or to subsequent action of the muscles exerted upon them, this action being increased by the muscular spasm which is usually present. Deformity may be obscured when present by swelling and by the deep situation of the fractured bone. For its recognition we take advantage of the natural bony prominences, using them as points from which to take measurements, and comparing the injured member with the uninjured one. The displacement which takes

FIG. 37.



Impacted fracture.

place between the fragments may be transverse or lateral, longitudinal, angular, rotatory, and that due to depression or impaction. In transverse displacement the ends of the fragments are not entirely separated, but slip partly by each other. In longitudinal displacement, which may be in the direction of shortening or lengthening, the ends either overlap or are drawn apart by muscular action, as in the olecranon and patella. In rotatory displacement one of the fragments rotates on its axis, being turned outward or inward, either by the weight of the limb below the fracture or by the action of the muscles. In angular displacement the relation of the fragments is so altered by the fracturing force, the weight of the limb, or muscular action, that they form an angle at the point of fracture. The terms depression and impaction have already been explained.

In examining for deformity it is well to compare the injured member with its fellow on the opposite side, especially when any doubt exists as to the diagnosis. Inspection, palpation, and careful measurements must be made, and the two sides compared. In addition to the swelling of the limb around the fracture, it is not uncommon to have an effusion in the neighboring joint, if the fracture be situated near it, and this condition should be kept in mind.

*Mobility.*—This is a very important symptom of fracture, and where it can be detected is absolutely confirmatory. It is usually present; being absent, however, in impacted fracture, and difficult of detection at times, if the fracture is very near an articulation, in which case it is often difficult to distinguish preternatural mobility from the normal movement in the joint. Where the bone is deeply situated and covered by muscle and fascia preternatural mobility may also escape detection. In examining for it, the ends of the bone are firmly grasped and manipulated in a lateral and anteroposterior direction; or the lower end is rotated while the upper end is palpated to determine if there be any interruption in the continuity of the bone. Great gentleness is necessary in these manœuvres to avoid causing pain or damaging important contiguous structures.

*Crepitus.*—When the two surfaces of bone at the seat of a recent fracture are rubbed against each other there is produced a grating, known as crepitus, which can be detected by the palpating hand, and is sometimes audible with or without the aid of a stethoscope. As it is only produced where the rough fragments come in contact with each other, it cannot always be detected, being absent in case of overlapping, where fragments of soft tissue intervene, or after repair of the bone has commenced. In cases of impaction in which mobility is not present it cannot be elicited unless the bones be first unlocked. It may also be confounded with the grating in a joint the seat of recent or old inflammatory changes, and with crackling in the sheaths

of tendons, or even in collections of blood when palpated. In examining for crepitus, one hand is used to hold the bone at the seat of fracture, while with the other the surgeon makes extension, rotation, and lateral or anteroposterior manipulations, using the greatest care and gentleness. Crepitus may be absent, and the diagnosis still be made with ease by the presence of other symptoms.

*Loss of Function.*—This is usually present, and may be a symptom of considerable value. Occasionally, however, it is found wanting. Thus, a patient is occasionally able to walk with a fractured leg, if one bone alone be broken, and to use his forearm to some extent if the radius or ulna alone is fractured.

*Pain.*—This is usually present and sharp, being aggravated by disturbance of the fragments for purposes of examination and by muscular spasm, and by anything indeed which presses the fragments together. In children, in whom green-stick fracture of the clavicle is quite frequent, localized tenderness at the point of fracture is often the most valuable diagnostic symptom. Localized tenderness on pressure is of considerable value in diagnosis.

*Muscular Spasm.*—This is due to the sharp ends of the bones irritating the muscles, or to direct irritation of the motor nerve-trunks. It is often induced by slight movements of the fragments, and in the case of deep-seated bones surrounded by muscular tissue, as the femur and humerus, is frequently a valuable diagnostic sign.

*Echymosis* often appears after fracture, either within a few hours, or sometimes after a delay of several days, in which case it is due to blood extravasated from the bone and deeper structures. The formation of blebs, often filled with dark serum, at or near the site of a fracture is very frequently noted.

*Diagnosis of Fractures.*—A diagnosis is arrived at by a consideration of the history of the patient, both as to previous injuries and the present one, and a careful examination of the injured part to determine the presence of the objective symptoms described above. It is not necessary to elicit all of the symptoms which might possibly be present in order to make a diagnosis. All rough handling and the production of needless pain should be avoided. The use of an anæsthetic is valuable in doubtful cases, especially when the injury involves a joint; and advantage can then be taken of the anæsthetic stage for the reduction and dressing of the fracture if one be found.

The use of the *Röntgen rays* for the detection and study of fractures has been found to be of considerable value in doubtful cases. Examination with the fluoroscope will at times be sufficient; but in any case of doubt several plates should be made, and even then much care and caution must be exercised in interpreting the appearances of the bone shadows. The services of an expert in this department



are indispensable. The shadows in a skiagraph are distorted to some extent, because since the rays all proceed from a comparatively small point they are not parallel. The farther away from the plate the object is, the greater will be the distortion; also the portions of the object farthest removed from a perpendicular line between the point from which the rays diverge and the plate will be the most subject to distortion. Changing the plane of the plates also influences the shape of the shadow cast by the rays.

In cases in which the diagnosis of a fracture remains in doubt in spite of the most careful examination, the path of wisdom is to treat the patient as if a fracture existed, and to insist on the continuance of treatment until all doubt is dispelled or until under normal circumstances a cure would be expected.

The diagnosis of a compound fracture is usually easy. The presence of a wound in association with a fracture should at once arouse suspicion; and even if there be any doubt as to its communication with the seat of fracture, prompt precautions should be taken to guard against possible infection of the wound, and all careless probing should be scrupulously avoided.

#### TREATMENT OF FRACTURES.

The principles of treatment to be observed are, first, to restore the fragments as nearly as possible to their normal position, bringing the ends in contact as accurately as possible, and then retaining them in that position while the process of repair is going on, at the same time practising such other measures as may be indicated for the restoration and maintenance of normal nutrition in all the tissues of the affected part, and also exercising due regard to the general condition of the patient.

The first indication, and one which should be met as soon as possible, is the reduction, or setting, of the fracture. Before doing so, however, all the appliances for dressing it should be at hand, so that there will be no necessity of repeating the manipulations. The advantages of early reduction are that the pain is usually markedly relieved thereby, and it can be much more easily executed before swelling and inflammatory reaction have ensued, and with much less pain to the patient. The bones are not in a condition for the process of union to take place for several days after the fracture, or even longer, so that reduction can be carried out at a later period; but unless some special reason exists primary reduction should be practised.

Reduction is accomplished by extension and counter-extension, to overcome the action of the muscles producing or keeping up the deformity, at the same time placing the part in such a position as will aid in relaxing the muscles acting on the fragments. While the



surgeon or his assistant makes extension on the lower fragment, he also practises manipulation, making lateral pressure where needed to overcome a transverse displacement. The muscular spasm which is usually present is generally overcome by flexing the joints, and thus relaxing the muscles, and by steady traction; but an anæsthetic may be required in some cases. It is sometimes impossible to restore the fragments, even temporarily, to their normal position, as, for instance, where the bones have been badly crushed or where impaction has resulted; and in the latter case it may be extremely injudicious to attempt it, as, for instance, in impacted fractures of the neck of the femur in old persons, in whom reduction would probably eliminate all chances of obtaining bony union. The fact that it is impossible in many cases of simple fracture to be sure that accurate adjustment of the fractured surfaces has been secured, and the freedom from suppuration which under good surgical technique has been obtained in operative wounds, have worked and are still working a revolution in our ideas of treatment of simple and compound fractures. Many surgeons, therefore, at the present day do not hesitate to expose the fragments in a simple fracture when satisfactory apposition cannot be obtained, or where deformity recurs in spite of ordinary retentive apparatus; and practise one of the several methods of uniting the fragments which will be described under the treatment of compound fractures. Under such circumstances the wounds usually heal kindly, and union takes place promptly and satisfactorily, the evacuation of blood and lymph from the tissues seeming to be an advantage rather than otherwise.

*Tenotomy* of certain muscles is another operation which has its sphere of usefulness in overcoming the tendency to displacement from muscular spasm, as in the case of Pott's fracture, and fracture of the tibia and fibula, where division of the tendo-Achillis will exceptionally be of great assistance in securing and maintaining reduction.

After reduction, and before applying retentive apparatus, it will usually be found advantageous, especially when the fracture is near a joint, to surround the part with lint soaked in an evaporating lotion, such as lead-water and laudanum or lead-water and alcohol, which application may be renewed at subsequent dressings for the first few days. The advantages are diminution in the pain and swelling of the soft parts which are consequent on most fractures; and these advantages more than counterbalance any softening of the skin or other disadvantages which have been claimed to arise from their use. If they are used for only a few days, there is no good reason to believe that there is any interference with union caused by them. Of course, where there is little tendency to local swelling and inflammation the use of these sedative applications is unnecessary. If desired, ichthyol

ointment of a strength of 25 per cent., spread on lint, may be employed as a substitute; or the limb may be simply enveloped in cotton.

**Apparatus for the Retention and Immobilization of Fractures.**—The almost universal practice of surgeons in the treatment of fractures is to immobilize the fragments as completely as possible in their normal relations with each other, and to retain this immobilization until union of the bones has advanced so far that ordinary use of the limb or part will not disturb the relations. For this purpose many forms of splints and special appliances have been devised, the ingenuity of surgeons seeming to have little limitation in this direction. The methods of treatment that have best stood the test of time are those possessing the merits of simplicity and readiness of application. The materials required for the treatment of fractures include splints of various kinds, bandages, compresses, plaster-of-Paris, silicate of potassium or sodium, or other forms of fixing material; and for use in special fractures other appliances, such as fracture-boxes, extension apparatus, racks and cradles, fracture-beds, etc.

**SPLINTS.**—These are constructed of a variety of materials. The most useful and generally applicable are made of light wood, such as white pine, willow, or poplar, from an eighth to a quarter of an inch in thickness, and of various widths and lengths according to the part to which they are to be applied. Both straight and angular splints are employed, the latter for fixation of the elbow in fractures of the upper extremity.

Carved splints of various shapes are supplied in the instrument-shops, but the main objection to them is that it is difficult to obtain one of the exact contour of the part to which it is to be applied. The

*fracture-box* is a form of splint for treatment of fractures of the lower extremity (Fig. 38).

It consists of a flat piece of wood with a foot-piece and sides, the latter hinged and opening outward, and the foot-piece provided with slits through which bandages are passed to secure the foot to it. When it is applied

a pillow is placed on it, the foot and leg adjusted in it, and the foot secured, and the sides are then raised and fastened so as to give firm lateral support. A variation of the usual form is found in the double-inclined fracture-box, which is occasionally, but rarely, used in the treatment of fractures of the thigh. Other forms of splints of special design are Volkman's splint, Levis's splint, Bond's splint, etc. Splints may be made of tin or wire carefully padded; of pasteboard and felt, which are cut into appropriate shapes, and after softening by dipping in hot water

FIG. 38.



Fracture-box with movable sides.

are carefully padded and moulded to the limb, making excellent splints. Splints are very often constructed of plaster-of-Paris, either by applying the ordinary plaster-of-Paris bandage, which is allowed to harden and then cut, thus forming an accurately moulded support, or by soaking pieces of crinoline cut into the desired shape in a cream made by mixing the plaster with water, and then applying a number of layers to the part, and bandaging them into position until dry (Fig. 39); or the dry plaster may be rubbed into the crinoline,

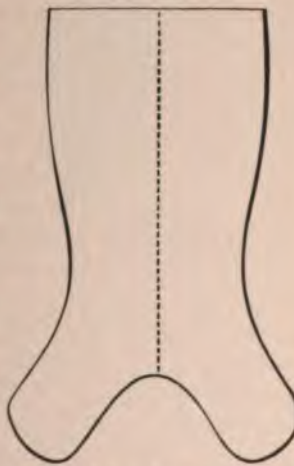
FIG. 39.



Posterior plaster-of-Paris splint or gutter. (Stimson.)

layer by layer, on a flat surface, one layer being superimposed upon the other until a sufficient thickness is obtained, and the dressing then wrung out of hot water, moulded to the part, and bandaged in position. Plaster-of-Paris may be used to form a hinged splint of value in treating fractures of the leg: two pieces of muslin are each cut into a shape that will enclose the limb (Fig. 40), and after superimposing one upon the other are stitched together in the median line. A number of layers of crinoline are cut a little smaller than each half of the muslin, soaked in the plaster-of-Paris cream, and placed between the layers of muslin, which are then folded around the limb, so that the seam corresponds to the median line of the calf of the leg, and the dressing bandaged in position. The hem acts as a hinge, which permits of ready removal of the dressing and inspection of the limb.

FIG. 40.



Stocking or bivalve plaster splint. (Stimson.)

**BANDAGES.**—The ordinary bandages used in the treatment of

fractures are made of muslin, and are of various widths according to the part to be dressed. They are used to hold splints in position, to retain compresses and extension apparatus, to prevent the movement of the part, and sometimes to prevent or overcome muscular spasm and swelling; in the latter case they constitute what is known as the *primary roller*, which is placed next the skin, and is especially applicable to fractures of the upper arm, the thigh, and the knee. Care is necessary in the application of the primary roller, as swelling following its application may result in too great constriction of the limb, interference with circulation, and gangrene. For this reason it should not be applied under flat splints, as in fracture of the forearm; and when applied under any circumstances careful watch should be kept that it does not exercise injurious compression. Flannel bandages are used as primary bandages before the application of the plaster-of-Paris bandage, as their elasticity allows the application of the bandage without the use of reverses, which are liable to cause creases in the skin and to become uncomfortable. Crinoline bandages, the meshes of which are impregnated with plaster-of-Paris, are used in applying plaster casts.

COMPRESSES are used to maintain fragments in position after reduction, and also to protect prominent portions of the bone from pressure by the splints. They are made of lint, oakum, muslin, cotton, etc.

ADHESIVE PLASTERS are of great service in the treatment of fractures. They constitute the essential part of the dressing itself in the case of fractures of the ribs. They are also used in the making of extension apparatus, for retaining splints, compresses, etc., in position, and for covering in a finished dressing to prevent displacement of the bandage. The most used are the rubber adhesive and the resin plaster; the latter requires exposure to heat before applying. The rubber plaster adheres the more firmly and is easier to apply; but has the disadvantage of causing at times much excoriation of the skin, especially in the tender skin of children and in hot weather. A plaster known as zinc oxide plaster has lately been introduced, and has the virtues of the rubber plaster without being so liable to cause irritation. Before applying adhesive plasters to the skin, the latter, if it contains any hair, should be carefully shaved; and care should be exercised also to avoid irregular or injurious pressure, or circular constriction of a limb. When strips of plaster are used to hold splints in position, the avoidance of drawing them tightly is especially to be enforced, as the straps, of course, are absolutely inelastic, and a very moderate degree of swelling may cause extensive pressure-sloughs.

**Massage in the Treatment of Fractures.**—In place of the usually accepted methods of treatment of fractures, in which the ideal



sought is the attainment of absolute fixation of the fragments, usually obtained by the abolition of function during the process of repair, another method of treatment has in recent years attracted considerable attention, viz., treatment by massage. Massage has long been used in the late stages of fracture, in combination with fixed dressings, and has steadily grown in favor. In the method under discussion, however, retention apparatus is dispensed with altogether by some of its most enthusiastic advocates, or used only when there is marked tendency to displacement of fragments. Thus, in fracture of the clavicle the arm is supported by a sling between the *séances*. The use of massage is begun immediately after the injury, the limb being

FIG. 41.



Fracture three weeks old: periosteal and medullary callus partly ossified, partly cartilaginous. P, periosteum. K, bone. M, medulla. (Tillmanns.)

FIG. 42.



Fracture healed with deformity (callus luxurians). (Tillmanns.)

either held by an assistant, who keeps up extension, or laid upon a sand-bag. The manipulations are directed in the course of the muscular fibres and blood-currents, and to the neighboring joints as well; but no great pressure is made over the seat of fracture. The treatment is carried out for from fifteen to twenty minutes daily. The advantages claimed by its advocates for this method are acceleration of healing, avoidance of muscular atrophy and ankylosis, and diminution of pain. As an exclusive method of treatment, the use of massage has not as yet found its way into great favor.

**Repair of Fractures.**—After fracture the space between the ends of the fragments is filled with blood-clot and serum; into this the cells from the periosteum, the soft parts, and the bone migrate. It is usual to speak of the callus by which union takes place as consisting of three portions—the external, the intermediary, and the internal callus. The external callus is formed mainly from the periosteum, the internal from the medulla. The bone itself also contributes. The intermediary callus is derived from both sources. The first tissue formed is called the osteoid substance, and in it are imbedded the cells or osteoblasts which have wandered out from the periosteum and bone. Hyaline cartilage is also produced. Later, lime-salts are deposited, and Haversian canals appear, and the callus becomes converted into spongy bone, in which the deposition of bone-tissue by the osteoblasts continues until the ends of the bone are united by a fusiform swelling (Fig. 41). The outer layer of provisional callus is largely absorbed, and the smaller or definitive callus, mainly formed from the medullary substance, remains. Later the callus is converted into true bone continuous with the original, and the medullary canal is restored. The union by callus is firm and complete in from three weeks to three months, but the process of conversion into true bone goes on for a year or more. Repair may take place in cases in which there are great overlapping and displacement of the fragments, and in such cases the medullary canal is more or less completely restored (Fig. 42).

#### FRACTURES OF SPECIAL BONES.

**Fractures of the Nose.**—These include fractures of the nasal bones, of the septum, and of the nasal processes of the frontal bone and superior maxilla. The fracture is commonly comminuted, and situated near the lower border of the nasal bones, both of which are usually involved. The common cause is direct violence. The cribriform plate of the ethmoid may be involved, and by the same injury other bones of the skull fractured. The nasal cartilages are not infrequently torn loose or broken. The fracture may be compound through laceration either of the skin or mucous membrane.

The deformity consists either in lateral displacement, depression, or a combination of the two. There is often much swelling of the soft tissues, which may mask the deformity. The septum is often subject to deviation and injury, as can be determined by inspection and exploration of the nares. Other symptoms are mobility, crepitus, epistaxis, and emphysema. Mobility is detected by grasping the nose firmly and making lateral pressure. Crepitus may be elicited by the same manœuvre. Hemorrhage is often free, usually subsiding soon, but occasionally returning at intervals, and proving very obstinate. Emphysema is usually due to attempts at blowing the nose when the

mucous membrane and periosteum are torn, and extends to the eyelids and face. The air is absorbed later and causes no serious symptoms. If the fracture be compound and suppuration occurs, there may be necrosis of the bones and cartilages. Hæmatoma of the septum is a not infrequent complication.

**TREATMENT.**—Careful attempts should be made at thorough reduction as soon as the fracture is recognized. Union takes place very rapidly, and reduction soon becomes impossible. As the manipulations are often painful, etherization may be called for, or the mucous membrane of the nares may be cocainized. Reduction is accomplished by manipulation from without, in some cases, especially when depression exists, supplemented by pressure from within by a strong director wrapped with cotton, and small enough to be inserted between the nasal bones and the septum. The latter should be straightened if broken or dislocated to one side. Often there is no tendency to return of deformity, and nothing is needed in the shape of dressing except a protective one. When there is deviation of the septum or depression, the fragments must be supported afterward until union takes place. This is accomplished by packing the nares with gauze strips, around pieces of catheter inserted on either side, by the employment of steel pins as suggested by Roberts (Fig. 43), or by the use of the Ash tubes. If these do not answer, a steel pin may be used to transfix the nose, and thus hold the fragments in position, a strip of adhesive plaster being placed over the bridge of the nose and the ends of the pin, to produce further fixation. For lateral deviation the simplest device consists of a small roll of lint on the side of the nose, held in position by strips of plaster. This is often unsatisfactory if there is a strong tendency to return of the deformity, and ingenious devices have been resorted to to keep up a constant lateral pressure. The simplest is a tin splint with a wide base, which is secured to the forehead by a bandage, and from this a gutter-like projection which fits over the bridge of the nose. Cobb's and Coolidge's splints are more complicated, and therefore less frequently available. Several strips of gauze secured to the cheek and nose by collodion may be used to correct a lateral deviation of the nose. Whatever form of treatment be used, the nasal passages should be kept clean by the use of antiseptic douches if there be any tendency to infection.

**Compound Fractures.**—If the fracture is compound through the skin, it should be treated antiseptically, detached fragments removed, and thorough reposition practised. If the mucous membrane is torn,

FIG. 43.



Roberts's method of pinning nasal septum.



antiseptic douches will be required. Abscesses may require opening, and necrosed fragments will call for removal.

For the saddle-back nose left after there has been great depression which has not been corrected, Weir and others have inserted artificial supports, such as splints of aluminium, gutta-percha, or celluloid, either under the skin or inside the nostril, by which the contour of the nose is effectively restored.

**Fracture of the Superior Maxilla.**—The body of the superior maxilla is seldom fractured, but its processes are more frequently broken, and always as a result of direct violence, and the neighboring bones of the face are often injured at the same time. The alveolar process may be broken off alone or in combination with the palatal process and the pterygoids. The nasal process is often involved in fractures of the nose. Cases have been reported in which the two bones separated in the median line, in which the fissures corresponded to the bounds of the intermaxillary bone, and, finally, in which the whole maxilla was forcibly driven backward on one or both sides. All of the fractures of this bone are, from the nature of the injury, liable to be extensively comminuted, and may be complicated by fracture of the base of the skull. Other complications which may arise are emphysema following fracture of the nasal process, obstruction of the lachrymal duct, injury of the infra-orbital nerve in its passage through the bone, and hemorrhage; necrosis may take place after great comminution, but extensive necrosis is uncommon, the fragments retaining their vitality to a marked degree.

**DIAGNOSIS.**—This is easily made by inspection and palpation from without and from within the mouth.

**TREATMENT.**—Reduction should be carefully instituted. All loose fragments should be respected, unless absolutely detached, as they usually retain their vitality. After reduction

FIG. 44.



Dressing for fracture of the upper jaw.

FIG. 45.



Gunning's interdental splint.

the lower jaw should be bound firmly against the upper by a Barton



or Gibson bandage (Fig. 44), to act as a splint. If the alveolar process be broken, the teeth may be wired together on either side of the fracture, or, which is probably preferable, an interdental splint moulded over the teeth, and used to hold the fragments in apposition (Fig. 45), the lower jaw being held against it by a bandage. Interdental splints of a satisfactory nature are sometimes made by cutting grooves in pieces of cork, to correspond to the upper and lower lines of teeth, and after inserting them in the mouth binding the jaws together upon them. The fracture should be inspected every two or three days at first. Whatever means of fixation be employed, a liquid or semi-liquid diet will be called for, and the mouth should be kept clean by antiseptic washes. Union takes place in from four to six weeks.

**Fracture of the Inferior Maxilla.**—This is the result of direct violence to the side or point of the chin, most commonly the latter, as a result of kicks, blows, or falls. A portion of the alveolus is occasionally broken off in attempts at extraction of teeth. The fracture may be in the body of the jaw (Fig. 46), the alveolus, the ramus, the coronoid process, or the condyloid process. Fracture of the body of the jaw is common, the other forms much rarer. The most common seat of fracture is in the anterior portion and at the median line. The fracture is not infrequently multiple, but seldom comminuted. It is very often compound, through laceration of the mucous membrane, and sometimes externally.

**SYMPTOMS.**—These are pain, inability to move the jaw, deformity, mobility, and crepitus. Localized pain and tenderness on motion and palpation may be the chief symptoms in fractures of the ramus and condyloid process. Mobility and crepitus are elicited by manipulating the fragments with the fingers grasping the body of the jaw. Deformity consists in irregularity of the dental border, overlapping of the fragments, and, in case of fractures of the condyloid process, deviation of the chin to the affected side. In fracture of the ramus the deformity is not conspicuous, as the fragments are surrounded by the masseter and internal pterygoid muscles. In fractures of the condyles, in addition to deviation of the chin to that side, the condyle can be felt to remain motionless while the jaw is moved, and can be pushed forward into the zygomatic fossa. There are localized pain on movement, and crepitus. Swelling of the tissues of the face frequently accompanies fracture of the jaw. Suppuration and necrosis are not infrequent sequelæ,

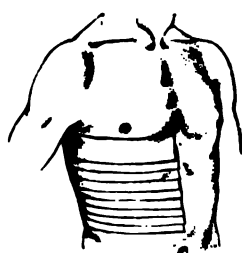
FIG. 46.



Fracture of lower jaw behind the teeth. (Stimson.)

plaster. Either rubber or resin plaster may be used, and the strips should be two and one-half inches wide, and long enough to extend a little beyond the median line of the back and front of the chest. In their application the patient stands or sits, and the surgeon, standing to one side, fixes the end of the first strip on the back, at the level of the lowermost rib, and brings it tightly around the chest, while the patient exhales. This procedure is repeated, the strips of plaster ascending, and each one overlapping one-third of the preceding,

FIG. 50.



Adhesive plaster dressing  
for fracture of the ribs.  
(Hamilton.)

until the axilla is reached (Fig. 50). The chest on the injured side is thus fixed in the position of contraction, and the pain is usually immediately relieved. The patient will, however, usually be more comfortable in the sitting position for the first few days. The strapping can be removed at intervals when it becomes loosened, and dispensed with at the end of three or four weeks, when union will be firm. Complications such as emphysema, pneumothorax, and hæmothorax will demand appropriate treatment. Emphysema usually passes off spontaneously. Collections of either air or blood in the chest may demand aspiration.

**Fracture of the Costal Cartilages.**—This is a rare injury. It may be due to either direct or indirect violence, or to muscular action. The cartilages of the seventh and eighth ribs are the ones most frequently injured, and the line of fracture is usually vertical and associated with overlapping. It has been met with in both young and old, being probably commonest in the latter.

**SYMPTOMS.**—These are pain, a prominence at the site of fracture, and perhaps soft crepitus and mobility.

**PROGNOSIS.**—This is good, union taking place by bony callus.

**TREATMENT.**—This is the same as that for fracture of the ribs.

**Fracture of the Sternum.**—Fracture of the sternum is rare, owing to its elastic attachments. It occurs as a result of direct or indirect violence, as from blows and falls, and from overextension or overflexion of the body; also from muscular action, as straining in parturition and in lifting heavy objects. The fracture may be transverse, oblique, or longitudinal, the former being the common variety; and may involve any portion of the bone, the manubrium, gladiolus, or xiphoid (Fig. 51). Instead of a fracture, it may really be of the nature of a diastasis, the separation taking place at one of the lines of junction of the three portions of which the bone is composed, and the ossification of which may be incomplete. The deformity usually consists in overlapping of the upper or lower

fragment; the former when the injury is due to extreme flexion of the body, the latter when it is caused by hyperextension. There may be depression instead of overlapping. The fracture is not infrequently complicated by injury to other bones, as the ribs and vertebræ, and the lung, heart, or pericardium may also be injured.

**SYMPTOMS.**—These are localized pain, which is like that accompanying fracture of the ribs, being increased by deep respiration, pressure, coughing, and movements. Deformity will probably be present, and mobility and crepitus can sometimes be elicited. In several cases diastasis of the xiphoid cartilage, with depression, has been attended by persistent vomiting, only relieved by elevation of the cartilage. Hemorrhage may be present; and if blood collects in the anterior mediastinum it may cause alarming symptoms and death. In the later stages abscess and necrosis may be present, the abscess usually pointing to either side of the sternum or at the xiphoid cartilage. Depression of the fragments with injury to the lung is accompanied by dyspnoea, hæmoptysis and emphysema.

**TREATMENT.**—Reduction of deformity should be attempted if present, and the most satisfactory means is by overextension of the head and shoulders, thus exerting traction on the upper fragment, in combination with direct pressure



FIG. 51.  
Transverse fracture of the body of the sternum. (Stimson.)



FIG. 52.  
Adhesive plaster dressing for fracture of the sternum.

and manipulation of the overriding fragment. If unsuccessful, and if the symptoms of pressure continue, operative interference is warranted, and consists in incision, elevation of the depressed fragment, and wiring of the fragments if necessary. After reduction of fractures of the sternum a compress should be placed over the seat of fracture, and the anterior portion of the chest covered by adhesive strips, applied from below upward and extending to the mid-axillary line on each side (Fig. 52). This dressing must be worn for four weeks, being renewed at intervals when the straps become loosened.

**Fracture of the Clavicle.**—Fracture of the clavicle is a very common form of injury. The clavicle forms the only bony connec-



tion between the upper extremity and the trunk, and is thus exposed to indirect violence from falls upon the arm or shoulder, the force being transmitted to it. It is most frequently broken in childhood, the fracture often being incomplete; but fracture in adults is also frequently met with. The seat of fracture may be in the outer, middle, or inner third. Fracture of the middle third (Fig. 53) is the commonest, and of the inner third the rarest, variety. The usual cause is indirect violence from falls upon the hand, arm, or shoulder. Crushing force applied to the upper part of the chest

FIG. 53.



Oblique fracture of the clavicle. (Stimson.)

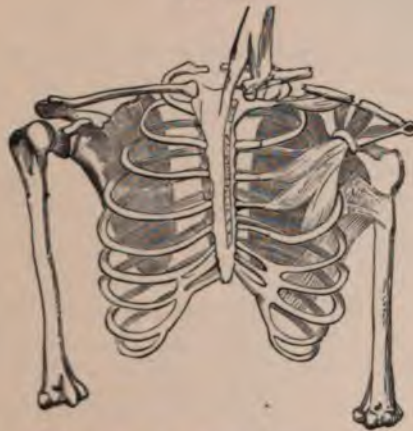
may produce it. Much less common are the cases due to direct violence, as a blow, and to muscular action, such as striking, lifting heavy weights, or making other violent muscular efforts. Gurl has collected twenty cases due to muscular action, to which Plat has added seven others. The line of fracture is usually oblique in adults and transverse in children. In the outer third the transverse variety is most frequent. Fractures of the outer third appear often to escape recognition. The fracture is rarely multiple or bilateral. A bilateral fracture has occurred in infants during birth.

**SYMPTOMS.**—The symptoms of this injury are very striking in adults, but may be quite inconspicuous in children, and are often overlooked at this age. In complete fracture of the middle third, the usual variety, the deformity is very marked. The weight of the upper extremity carries the outer fragment downward, the shoulder dropping, of course, with it, the displacement being increased by the action of the serratus magnus, latissimus dorsi, and pectoralis major and minor muscles; by the action of the pectoralis muscles the arm is drawn forward and inward, causing the outer fragment to under-ride the inner one. The inner fragment in oblique fractures is simultaneously drawn upward by the action of the sterno-cleido-mastoid (Fig. 54). The patient supports the injured member by its fellow, and, unaided, cannot carry it to his head nor to the opposite shoulder. Fractures of the outer third are not usually attended with much deformity, especially if the fracture be in the limits of the coraco-clavicular ligaments; when present, it is usually an angular displacement backward. In fractures of the inner third, which are



very rare, the displacement may be in various directions, the most common being downward displacement of the inner end of the outer fragment or of both fragments. Besides the characteristic attitude and deformity, pain and localized tenderness are present, with crepitus when the arm is lifted and the ends of the bone brought into contact.

FIG. 54.



Displacement of inner and outer fragments in fracture of the clavicle. (Dennis.)

In children, as has been remarked, the symptoms are often very slight and misleading. After a slight fall the child will cry if lifted or its arm pulled upon, and examination should always be directed to the clavicle in such cases. Localized tenderness and, after a few days, a swelling at one point, with little or no deformity, are often the only additional symptoms.

*Complications* occurring in simple fractures of the clavicle are rare. The brachial plexus and subclavian vessels may be injured by the sharp ends of the fragments, and the brachial plexus may be involved in the callus. The internal jugular vein has also been injured. *Compound fractures* of the clavicle are rarely observed.

**PROGNOSIS.**—Fractures of the clavicle unite promptly, and examples of non-union in this fracture are extremely rare. Repair of this injury without deformity is also a very rare occurrence; there is usually some shortening, with more or less angular deformity, following cases of oblique fracture of the clavicle; but, although the deformity may be marked, the functional result is generally very satisfactory.

**TREATMENT.**—In the treatment of fracture of the clavicle the principal indication is to carry the shoulder upward, outward, and backward—that is, to restore it to its normal position, and thus bring the acromial fragment, the one principally displaced, to its proper

place. Although this may be easily accomplished by manipulation, great difficulty is experienced in keeping the shoulder in this position, for the unsupported weight of the shoulder tends to cause a reproduction of the deformity.

The movement of the scapula is an important factor in the production of deformity after fracture of the clavicle, and any dressing which does not secure fixation of this bone cannot fulfil the indications in treatment.

*Treatment in the Recumbent Posture.*—By this method of treatment excellent results may be obtained with the least amount of deformity; but the position is irksome, and many patients will not submit to it. The patient should be placed upon a firm mattress, and the head placed on a low pillow, with the chin slightly depressed, so as to relax the sterno-cleido-mastoid muscle and relieve the tension upon the sternal fragment of the clavicle. A folded towel should be placed in the axilla, to protect the surface of the arm and chest from excoriation, and the arm and forearm on the injured side should be flexed and placed across the chest, so that the fingers of the arm of the injured side will touch the opposite shoulder. In this position the inferior angle of the scapula moves forward and the superior angle backward, the weight of the body upon the lower angle keeping it in this position. The arm should be secured in place by broad strips of adhesive plaster or by a few turns of a roller bandage. It is remarkable in cases of fracture of the clavicle with great deformity how the parts assume their normal position if the patient is placed in the recumbent posture with the arm in the position just described. After the patient has remained two or three weeks at rest in this position union is generally sufficiently firm to allow him to get out of bed and be about with the arm bound to the side and the forearm carried in a sling or with a Velpeau bandage applied.

*Treatment in the Erect Posture.*—In treating a fracture of the clavicle in this posture the reduction of the deformity in the fractured bone is accomplished by carrying the shoulder upward, outward, and backward; but great difficulty is experienced with any form of dressing in keeping the shoulder from dropping and the scapula from rotating, producing recurrence of the deformity.

*Temporary Dressing for Fracture of the Clavicle.*—This may be accomplished by the application of a four-tailed bandage, made from a piece of muslin two yards in length and fourteen inches in width. A hole is cut in the centre, about four inches from its margin, to receive the point of the elbow; the bandage is then split into four tails in the line of the hole and to within six inches of it. The body of the bandage should be applied so that the point of the elbow rests in the hole, and, a folded towel being placed in the axilla, the

tails should be carried, one anteriorly, the other posteriorly, fully across the chest and back to the neck on the side opposite to that of fracture, and secured; the remaining tails are next carried to the lower part of the chest and secured, so as to fix the arm to the side of the body. In the temporary dressing of fracture of the clavicle the same indications may be met by utilizing the clothing to draw the arm to the side and to form a sling, supporting the elbow on the opposite shoulder.

*Velpeau Dressing.*—This dressing will be found a most satisfactory one in a large number of cases. The flexed arm carried

across the chest draws the lower end of the scapula forward by tensing the *teres major*, and causes the acromial end of the clavicle to rise and backward. The position of the arm upon the chest also helps to keep the scapula outward (Fig. 55). In dressing a fracture of the clavicle in this position, the arm should be brought across the front of the chest so that the hand will rest on the shoulder of the sound arm. A folded towel should be placed in the axilla and between

FIG. 55.



Velpeau's bandage for fracture of the clavicle.

the arm and side of the chest, to prevent excoriation of the skin surface.

A modified form of the *Velpeau dressing* is applied as follows: A towel or a piece of lint should be placed in the axilla and allowed to extend over the side and front of the chest, and held in place by a strip of adhesive plaster. The arm is next placed in the *Velpeau position*, and a good-sized pad of lint is applied over the scapula and held in place by a strip of adhesive plaster, two and a half inches in width and one and a half yards in length. The strip is continued downward and forward so as to pass over the elbow, and is carried diagonally across the chest to the other side of the opposite side and secured. A hole should be cut in the bandage to receive the olecranon process. A compress of lint is placed over the seat of fracture and held in place by a strip of adhesive plaster; an additional strip of plaster is next carried over the spine, under the arm and chest, and secured on the opposite side of the chest.

Circular turns of a roller bandage are then passed around the chest, including the arm, from below upward, until the arm is securely fixed to the body, and the dressing is finished by making one or two



turns of the third roller of Desault (Fig. 56). The time of removal of this dressing and its reapplication will depend upon the comfort of the patient and the manner in which the dressing keeps the parts in position. As a rule, in fractures of the clavicle the dressing should be removed at the end of the second or third day, the parts inspected, and the skin sponged with dilute alcohol; the dressings are then reapplied, and if the patient is comfortable and the parts in good position the dressings should be made at less frequent intervals until union is completed. Union is generally quite firm at the end of four or five weeks, and at this time the dressings

FIG. 56.



Modified Velpeau dressing for fracture of the right clavicle.

may be removed and the patient allowed to carry the arm in a sling for several weeks; but he should not undertake any work requiring forcible movements of the arm until eight or ten weeks have elapsed from the receipt of the injury.

*Sayre's Dressing.*—This dressing consists of two strips of adhesive plaster three and a half inches wide and two yards in length. The end of the first strip is made into a loop and secured by stitches, the loop passed around the arm just below the axillary margin, and the arm then drawn downward and backward until the clavicular portion of the

pectoralis major muscle is put sufficiently on the stretch to overcome the action of the sterno-cleido-mastoid muscle, and in this way draw the sternal fragment of the clavicle down to its place. The strip of plaster is then carried completely around the body and fastened or stitched to itself on the back. Before the elbow is secured by the second strip of plaster it should be pressed well forward and inward, and the forearm should rest across the anterior surface of the chest. The second strip is next applied, commencing upon the front of the shoulder of the sound side. From this point it is carried over the top of the shoulder diagonally across the back, under the elbow, and across the front of the chest to the point of starting, where it is secured (Figs. 57 and 58). A slit should be made in this strip to receive the projecting point of the olecranon process.

*Fracture of the Clavicle in Children.*—This fracture is very common in infants and children, and, as a rule, the deformity following is much less than that which is observed in adults. The fracture of the bone may be partial or complete, and the line of fracture trans-



au or the modified Velpeau dressing; and as these patients  
particularly apt to disarrange the dressing, it is well to render it

FIG. 57.



Velpeau's dressing for fracture of the clavicle. First strip applied.

FIG. 58.



Sayre's dressing for fracture of the clavicle. Second strip applied.

tionally secure by applying a few broad strips of adhesive plaster  
the turns of the roller bandage, the strips following the turns  
of the bandage.

The most troublesome complication in the treatment of fractures  
of the clavicle in children is caused by excoriation of the skin where  
the surface of the arm comes in contact with the skin of the chest.  
This may be guarded against by using a dusting-powder and by  
inserting a fold of dry lint between the arm and the side of the

The time required for union in fractures of the clavicle in

measure with good results ; and in cases with persistent deformity, especially if there were evidences of pressure on the brachial plexus, it would be advantageous. In compound fractures wiring has proved most satisfactory in my experience, and it should also be employed in the rare cases of non-union.

*Massage.*—Lucas-Championnière and others have recommended massage for from fifteen to thirty minutes daily, the arm being merely supported in a sling without other fixation during the entire course of treatment. The massage is applied to the seat of fracture and the neighboring joints and muscles, special attention being given to the deltoid, and is combined with active and passive movement of the shoulder-joint. Union with restoration of function is obtained, it is asserted, usually in from eighteen to twenty-five days.

FIG. 59.



Fracture of the body of the scapula. (Dennis.)

**Fractures of the Scapula.**—The scapula is rarely broken. Fractures of this bone, according to Stimson, comprise only 1 per cent. of all fractures ; Piatt encountered five fractures of the scapula in a series of six hundred and eleven fractures under his personal observation, a very similar ratio. Its exemption from injury is probably due to the fact that it is surrounded and protected by layers of muscle, and also that it moves freely over the chest with the arm, and is thus not so liable as the clavicle to feel the force of indirect or transmitted violence. In the consideration of fractures of the scapula

re is usually transverse or oblique below the spine (Fig. 59).  
 ture may be comminuted or partial. The spine itself may be  
 alone, or a longitudinal comminuted fracture may cross it.

*ptoms.*—These are deformity, more or less marked in complete  
 and more easily detected when the spine or lower angle is  
 mobility and crepitus. The latter symptoms are elicited  
 the upper margin of the bone and manipulating the lower  
 and angle. Incomplete fractures are difficult of recognition;  
 partial disability of the arm and pain on movement; non-  
 rare.

*ment.*—The deformity should be corrected, and a compress  
 over the scapula so as to prevent its return. The scapula  
 should be immobilized by the application of a Velpeau  
 or by circular bandaging of the arm and chest. The dress-  
 ould be retained for four weeks.

**ATURE OF THE CORACOID PROCESS.**—This is a very rare

It may be due to muscular action, to direct violence, and  
 set force transmitted from the  
 in dislocation of the latter  
 r to pressure of the process  
 the clavicle in forced flexion  
 ).

*ptoms.*—These are pain, mobil-  
 crepitus, and are obscure. The  
 may be recognized by palpa-  
 e the humerus is manipulated,  
 nent being drawn upon by the  
 rachialis and short head of the  
 Crepitus can be elicited by  
 manoeuvre. Union takes place by fibrous tissue in the great  
 of cases.

FIG. 60.

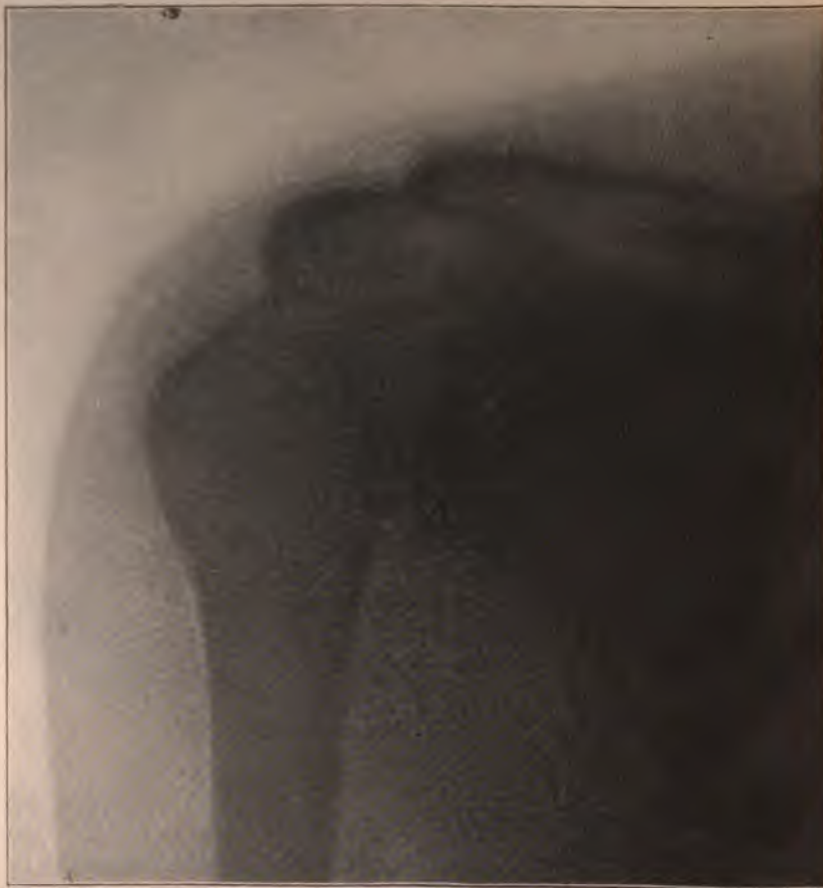


Fracture of the coracoid process.

overlooked (Fig. 61). In some cases the lesion is probably an epiphyseal separation. Fracture is produced by direct violence acting in a downward direction, a force acting from below on the humerus driving its head upward, and occasionally muscular action.

*Symptoms.*—These are flattening of the shoulder (due to the weight of the arm), mobility, and crepitus. The fragment moves

FIG. 61.



Skiagraph of fracture of the acromion process of the scapula.

with the arm, and can be pushed up into place and its mobility determined by manipulation of the arm. There is usually disability of the arm as far as raising it is concerned.

The symptoms have been confused with those of dislocation; but in fracture of the acromion the deformity disappears on pushing the humerus upward, and reappears immediately when it is allowed to drop; in dislocation the acromion can be felt sharply outlined, the



head of the bone is widely separated from it and can be felt in the axilla, and the flattening of the shoulder disappears on reduction of the dislocation and does not return.

Union usually takes place by fibrous tissue, the function being, however, unimpaired.

*Treatment.*—The dressing is the same as for fracture of the coracoid process, the arm being placed in the Velpeau position, with a pad in the axilla, and held by a Velpeau bandage. The dressings should be retained for four weeks.

**FRACTURE OF THE NECK OF THE SCAPULA AND OF THE GLENOID CAVITY.**—Fracture of the neck of the scapula is a very rare injury. The fracture may be through the suprascapular notch behind the coracoid process, or may separate the glenoid cavity, leaving the coracoid attached to the scapula (Fig. 62). Fracture of the glenoid cavity itself is very rarely recognized clinically, although there is reason to believe that it is of not infrequent occurrence. It may complicate a dislocation.

FIG. 62.



*Symptoms.*—These are a marked flattening of the shoulder, the fragment being carried downward by the weight of the arm, and contraction of the muscles attached to the coracoid process when the fracture is behind it, great prominence of the acromion process, mobility of the fragment, and crepitus, which is restored to its place by pushing the arm upwards. There is swelling of the arm.

*Treatment.*—The treatment is the same as for fracture of the coracoid process, the arm being placed in the Velpeau position, with a pad in the axilla, and held by a Velpeau bandage. The dressings should be retained for four weeks.

**Fracture of the Humerus.**—The humerus is the bone of the upper arm, and is the most common bone to be fractured. It is a long bone, and is divided into three parts: the head, the shaft, and the distal end. The head of the humerus is at the top, and is connected to the scapula. The shaft is the middle part, and is the longest part. The distal end is at the bottom, and is connected to the radius and ulna. The humerus is a very strong bone, and is capable of withstanding a great deal of force. It is also very mobile, and can move in many directions. The humerus is a very important bone, and is essential for the function of the arm.

The humerus is a long bone, and is divided into three parts: the head, the shaft, and the distal end. The head of the humerus is at the top, and is connected to the scapula. The shaft is the middle part, and is the longest part. The distal end is at the bottom, and is connected to the radius and ulna.

the tuberosities, (3) separation of the upper epiphysis, and (4) of the surgical neck.

1. *Fractures of the Head and Anatomical Neck of the Humerus—Intracapsular Fracture.*—Fractures within the limits of the capsule of the shoulder-joint include all fractures of the head of the humerus and most of those in which the line of fracture falls in the anatomical neck (Fig. 63). They are of rare occurrence unless combined with



FIG. 63.  
Fracture of the anatomical neck of the humerus, with slight splintering and fracture of both tuberosities. (Gurlt.)

other injuries, such as fractures of the tuberosities and surgical neck. They may complicate dislocations. Fractures of the head occur as a result of direct or indirect violence; of the anatomical neck, usually in consequence of direct traumatism.

*Symptoms.*—These are often obscure; there is very little displacement, although pain and disability may be quite marked. Crepitus can sometimes be elicited. When there is an impacted fracture there is flattening of the shoulder, with shortening of the arm, and the acromion is less prominent; in other cases the upper end of the lower fragment can be felt, and displacement of the upper fragment detected.

*Prognosis.*—This is not good in intracapsular fractures, and as it is often difficult to decide the exact limitations of the fracture, the

surgeon should be guarded in his expressions as to ultimate recovery of function. When the fragment is completely detached union is very liable to be wanting; the detached portion either atrophies, remains as a foreign body, or necroses and is extruded. Where impaction is present or the fragment not altogether detached, union may take place.

*Treatment.*—The use of an anæsthetic is valuable—indeed, almost indispensable—in arriving at a diagnosis where this injury is suspected. At the same time attempts may be made to reduce deformity if present, and the splints and dressings applied. The dressing for fractures of the head and anatomical neck is identical with that which will be described for fractures of the surgical neck. In cases of compound fracture of this portion of the bone primary excision will usually be indicated, and the same procedure might be practised in simple fractures with advantage as regards the improvement of function. In cases of combined dislocation and fracture, in which the head of the bone has been driven through a rent in the capsule, manipulation may be practised to reduce it. If this fails, open incision, with reduction or excision, as may seem indicated, should be practised. If

the head of the bone be entirely separated, the latter procedure will probably be preferable.

2. *Fracture of the Tuberosities of the Humerus.*—This is a rare injury, and comprises fracture through the tuberosities or splitting off of one or the other tuberosity. Fracture through the tuberosities may exist in connection with fracture of the anatomical neck, and sometimes occurs in this connection in dislocations. Splitting off of one of the tuberosities is usually a complication of dislocation also, the greater tuberosity being much more frequently broken than the lesser, and usually in association with anterior dislocations of the bone. The lesser tuberosity has very seldom been fractured, and usually as a consequence of upward dislocation. The greater tuberosity has also been fractured by muscular action (Fig. 64).

*Symptoms.*—The symptoms of fracture through the tuberosities are similar to those of fracture of the anatomical neck or a high fracture of the surgical neck. Splitting off of the greater tuberosity causes broadening of the joint, the fragment being drawn backward by the muscles attached to it, and the shaft drawn inward and forward by the action of the subscapularis and pectoralis major muscles. There are pain and crepitus and loss of power of voluntary outward rotation. In the very exceptional fracture of the lesser tuberosity the arm is rotated outward, and the fragment felt at the position of the lesser tuberosity.

*Treatment.*—Fractures through the trochanter should be treated like fractures of the surgical neck. Splitting fractures are best treated in the same manner, the arm being rotated somewhat in the direction of the detached fragment, with a compress over the latter.

3. *Separation of the Upper Epiphysis.*—The upper epiphysis of the humerus unites with the shaft at about the twentieth year in the majority of individuals. At any age up to the time ossification of the epiphyseal cartilage takes place, traumatism, either directly applied to the bone at this point, or exerted indirectly through the arm, as a cross-breaking strain, or traction, may cause a separation following the line of the epiphyseal cartilage. It is rather an unusual injury, but is easily recognized.

*Symptoms.*—These are marked displacement, localized pain and

FIG. 64.



Fracture of the greater tuberosity of the humerus united. (Stimson.)



tenderness, and, to a less degree, mobility and crepitus. The deformity consists in shortening of the arm, measured between the acromion process and the external condyle, when compared with the other side, and a wedge-shaped prominence in front of and below the shoulder (Fig. 65), which is produced by the upper end of the shaft

FIG. 65.



Deformity in separation of the upper epiphysis of the humerus.

forward, as can be determined by rotation of the elbow; the head of the bone is in the normal position, although the upper end is strongly flexed and abducted by the muscles attached to it. A portion of the periosteum connecting the two very bony surfaces. Crepitus is best elicited after reduction of the fracture. The arm hangs soft and cartilaginous in nature.



the side, the elbow perhaps supported by the other hand. The reduction is difficult and usually quickly recurs.

*Prognosis.*—This is usually good as regards function, although there is often persistence of deformity. There may be some restriction of motion, and occasionally interference with growth of the bone. Ankylosis is rare.

*Treatment.*—Both for purposes of diagnosis and reduction general anesthesia is invaluable. Reduction should be carefully instituted ;

FIG. 66.



Skiagraph of separation of upper epiphysis of the humerus.

the surgeon will often be disappointed in his efforts to keep the fragments in position. Fortunately, in spite of some deformity, the result is usually satisfactory as regards function. The dressing is the same as that which will be described under Fractures of the Surgical Neck of the Humerus.

*Fracture of the Surgical Neck of the Humerus.*—This, which is the most frequent fracture of the upper end of the humerus, and one very common in adults, includes all fractures between the tuberosities and the limits of insertion of the latissimus dorsi and teres major muscles. The usual cause is direct violence to the outer side of the shoulder, or a blow or fall on the elbow. The line of fracture may be either transverse or oblique.

*Symptoms.*—These are pain, disability, shortening, lateral deformity,

and preternatural mobility and crepitus. The fracture may be impacted (Fig. 67). The deformity consists in the lower fragment being

FIG. 67.



Fracture of the surgical neck of the humerus. (Dennis.)

drawn inward by the pectoralis major, latissimus dorsi, and teres major muscles, and upward by the clavicular fibres of the pectoralis major, the triceps, biceps, and coraco-brachialis. The upper fragment may be flexed, abducted, and rotated outward (Plate I.). Exceptionally the shaft is displaced outward and forward, instead of inward.

*Prognosis.*—This is good, the functional result usually being all that could be desired, and non-union is very rare.

*Treatment.*—The deformity is overcome by extension and manipulation. The most satisfactory dressing for all fractures of the humerus above the junction of the upper and middle thirds of the bone is applied as follows: a primary roller should be evenly applied from the tips of the fingers to the

seat of the fracture, the arm being flexed at the elbow before the bandage is carried above this point, to prevent the dangerous constriction which might result if the bandage were applied with the arm in the straight position and it were afterward flexed at the elbow. A folded towel or a thin pad of lint should next be placed in the axilla and over the outer surface of the chest, to furnish a firm basis of support for the humerus, and also to prevent excoriation from contact of the skin surfaces. A splint of pasteboard, felt, leather, or plaster-of-Paris (Fig. 68) is next moulded to the shoulder and arm; this should be long enough to extend some distance below the seat of fracture and wide enough to cover in about one-half of the circumference of the arm, and is padded with cotton and fitted to the shoulder and arm. The splint and arm are next secured to the side of the body by spiral turns of a roller bandage including the arm and chest in its turns and applied from the elbow to the top of the shoulder. The forearm is carried in a narrow sling suspended from the neck (Fig. 69). This dressing should be removed at the end of twenty-four or forty-eight hours, and after the parts have been inspected and sponged with alcohol the dressings should be reapplied in the same manner; and if the patient is comfortable they need not be disturbed again for three or four days, subsequent dressings being made at the same intervals. Passive motion should be begun at the end of the third week. In all injuries





the shoulder in persons past middle life passive motion and in the latter stages of treatment should not be omitted, as there is a great tendency to fibrous ankylosis, a tendency which, as in the case of fracture around the wrist in the same class of persons, has been thought by many to be more marked in those of a rheumatic habit. Union in fractures of the upper extremity of the humerus, except in *intracapsular* fracture, in which union is the exception, is usually quite firm at the end of five weeks, and the dressings can be dispensed with at this time.

FIG. 69.



FIG. 68.

splint for shoulder  
and arm.

Dressing for fracture of the upper extremity of the humerus.

**FRACTURE OF THE SHAFT OF THE HUMERUS.**—This includes fractures between the insertion of the latissimus dorsi and teres muscles and the base of the condyles.

**Causes.**—These comprise direct and indirect violence and muscular

The humerus is more often broken by muscular action than any other bone; the usual causative act is that of throwing or catching a ball; also the trial of strength in which two men try to pull each other's hands in opposite directions, this manipulation usually producing spiral fractures. The direction of the fracture is usually oblique; in children it is often transverse or comminuted.

**Complications.**—These are preternatural mobility, deformity, disability of the arm, crepitus, etc. The deformity varies: often the lower fragment is displaced upward and inward; it may take up a position similar to the upper fragment in oblique fractures of the lower third. The forms of displacement depend largely on the nature and direction of the fracturing force (Fig. 70).

Complications liable to arise are injury of the brachial artery or



vein, resulting in gangrene, or of one of the nerves of the arm at the time of injury, or involvement of a nerve in the callus during the process of repair. The musculo-spiral, from its intimate association with the bone in its passage through the musculo-spiral groove, is the nerve most likely to suffer. Non-union occurs with comparative frequency in the humerus; this is attributed by some writers to the fact

FIG. 70.



Skiagraph of fracture of the shaft of the humerus. (Roberts.)

that the humerus is intimately surrounded by muscular tissue, the interposition of which between the fragments acts to prevent repair. Another explanation is the difficulty of thorough immobilization of the bone and of the joints above and below. Either of these explanations may prove correct in individual cases.

*Prognosis.*—The prognosis is usually good, a strong and useful arm generally being obtained even in the face of more or less deformity.

*Treatment.*—The dressing consists in the application of a primary roller from the tips of the fingers to the seat of fracture; a short, well-padded, wooden splint extending from the axilla to a point a

little above the internal condyle is next placed on the inner surface of the arm and against the chest; a moulded pasteboard, felt, or plaster-of-Paris splint, fitted to the shoulder and outer side of the arm, and extending a short distance below the seat of fracture, is padded with cotton and applied to the shoulder and arm. The splints are held in position by the turns of a bandage, and the arm is secured

FIG. 71.



Internal angular splints.

to the body by spiral turns of a roller bandage carried around the chest and arm, and the forearm is carried in a sling suspended from the neck. The dressing is much the same as that for fracture of the

FIG. 72.



Dressing for fracture of the shaft of the humerus with internal angular splint and external splint of binders' board.

upper part of the humerus, with the addition of the short internal splint.

Fracture of the shaft of the humerus may also be dressed by first applying a primary roller and then placing the forearm and arm upon a well-padded internal angular splint (Fig. 71). Care should be taken to see that the end of the splint extends only to the axilla, and does not press upon the brachial vein. A pasteboard or felt moulded

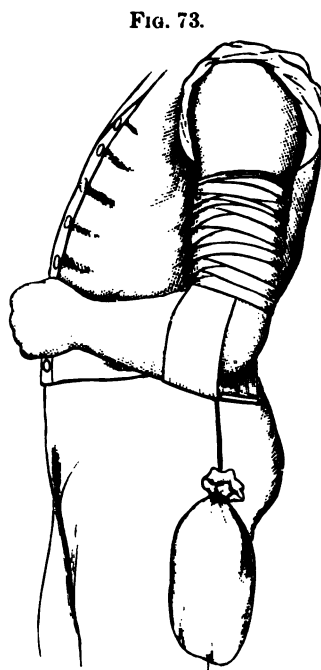
splint is next applied to the shoulder and outer side of the arm, and should be long enough to extend below the seat of fracture. The splints are held in position by turns of a roller bandage beginning at the fingers and carried up to the shoulder, and finished with a few spica-of-the-shoulder turns (Fig. 72). The arm is supported by a sling applied at the wrist, and sometimes for additional security the arm is bound to the side of the body by spiral turns of a bandage carried around the arm and chest. The after-treatment of these fractures as regards the removal and renewal of the dressings is the same as in cases of fracture of the upper portion of the humerus.

In fractures of the shaft of the humerus the dressings should be retained for five or six weeks.

Very rarely it will be found that there is a strong tendency to overlapping, which is not easily overcome by the use of splints and the counter-extension afforded by the weight of the arm. For such cases, which are much more unusual than one might suppose, rest in bed, with extension applied through adhesive straps to the humerus

below the seat of fracture, may be employed, or the ordinary ambulant dressing used, with a bag of shot or similar weight fastened to the arm so as to hang below the elbow (Fig. 73). Plaster-of-Paris may be employed, the dressing being applied while extension is made, and the bandages taking in the entire upper extremity, shoulder, and upper part of chest. Finally, for persistent deformity, not to be overcome by other means, it will be justifiable to cut down on the fracture and accurately fix the fragments by silver wire sutures, silver splints, or whatever form of suture the operator may prefer.

**FRACTURES OF THE LOWER END OF THE HUMERUS.**—These fractures are of common occurrence, especially in children, and from their intimate relationship to the elbow, and the liability to limitation in the movements of that joint as a consequence of the



Clark's extension in fracture of the humerus. (Dennils.)

injury, are a source of anxiety to the surgeon as well as to the patient and his family. Their diagnosis and treatment demand skill, intelligence, and watchfulness; and even with the greatest attention the

mand in every case in which fracture is even suspected ; and stage should be taken of the stage of anæsthesia to reduce the nity, if present, and apply the dressing.

actures in this region are divided into supracondyloid fracture separation of the lower epiphysis, and condyloid fractures. The include fracture of the internal and fracture of the external les, of their epicondyles, and T-fracture.

*Supracondyloid Fracture.*—In supracondyloid fracture the line cture occurs through the lower extremity of the humerus at ase of the condyles (Fig. 74). In

en the fracture may rarely consist separation of the lower epiphysis ; of course, is only possible before ation of the epiphyseal cartilage place. The line of fracture may ther transverse or oblique, most only the latter, and usually runs behind forward and above down- (Fig. 75). In the case of the sep-

a of the epiphysis the line of separation is transverse to the f the bone. The violence which produces the fracture is usu- direct, from force applied to the forearm or the hand. It may wever, in the nature of direct violence to the front or back of m.

*Symptoms.*—These are deformity, consisting usually of a backward cement of the lower fragment, and a prominence anteriorly of arp end of the upper fragment. There are usually shortening, as, and preternatural mobility. Exceptionally, the lower frag- is displaced forward. The symptoms are sometimes confused those of backward dislocation of the elbow. In the latter however, the olecranon process is no longer in line with the les, there is no true crepitus, and the deformity which is diffi-

FIG. 74.



Supracondyloid fracture of the humerus. (Hutchinson.)



FIG. 77.



Dressing for fracture of the lower extremity of the humerus with anterior angular splint.

bandaged in position (Fig. 77). It is often of advantage to place a moulded pasteboard cap, also well padded, over the posterior por-

FIG. 78



Skiagraph of fracture of the external condyle of the humerus. (Roberts.)

tion of the elbow, as an additional safeguard against recurrence of backward displacement. In the majority of cases this dressing will

be found eminently satisfactory. A plaster-of-Paris bandage may be used in place of the splints, being applied while the arm is held at a right angle, careful extension being made until the bandage has hardened.

Acute flexion, or Jones's method, as it is sometimes called, which will be described under the treatment of fractures of the condyles, is an excellent form of dressing in this injury. The dressing in supra-condyloid fractures should be changed at frequent intervals for the first ten days, and should be continued for four or five weeks. Passive motion may be instituted at the expiration of three weeks, being careful to fix the fragments while it is being applied.

*Fractures of the Condyles.*—Fractures of the condyles include separation of the internal or external condyle or epicondyle, and T-fracture, and are very frequently met with in children, but are not very common in persons in adult life. They result both from direct force applied to the elbow and from violence acting through the forearm.

FIG. 79.



Lines of fracture of the external condyle. (Stimson.)

*Fracture of the External Condyle.*—The line of fracture is usually oblique, and involves the articular surface of the humerus (Fig. 79). It is much more common than fracture of the internal condyle.

*Symptoms.*—These are pain, swelling, deformity, disability of the arm, crepitus, and mobility. There is widening of the lower end of the humerus, and the forearm usually inclines toward the ulnar side when in the extended position. The condyle is displaced downward, and when the condyles are grasped with either hand and manipulated in opposite directions the fragment can be felt to slide backward and forward.

*Fracture of the Internal Condyle.*—In this case also the line of fracture is usually oblique and involves the articular surface of the bone (Fig. 80). It is produced by both direct and indirect violence, probably most frequently the latter, and simulates dislocation when associated with much backward displacement. It may also be displaced upward, or even rotated. The *symptoms* are those common to fracture, and, in addition, there is an inclination of the forearm to the inner side during extension, due to upward displacement of the fragment.

*T-Fracture of the Condyles.*—In this fracture one line of sep-

aration runs through the condyles transversely and is joined near its middle by a vertical fissure, which separates them from each other (Fig. 81). It usually results from considerable force acting directly on the olecranon from behind while the arm is in a flexed position.

FIG. 80.



Upper and lower limits of fracture of the internal condyle. (Stimson.)

FIG. 81.



Inter-condyloid or T-fracture of the humerus. (Stimson.)

In this fracture the breadth of the elbow is markedly increased, and the condyles can not only be moved laterally upon each other, but also backward and forward upon the end of the upper fragment.

*Fracture of the External Epicondyle.*—The external epicondyle is rarely broken, owing to its small size. Extra-articular fracture has

occurred however. The cause is direct violence, and the fracture is easily overlooked. The displacement is slight, usually in the downward direction (Fig. 82).

FIG. 82.



Fracture of the external epicondyle of the humerus. (Gurilt.)

*Fracture of the Internal Epicondyle.*—The internal epicondyle is not infrequently fractured, especially in children, the causes being direct violence and muscular action. Fracture some-

FIG. 83.



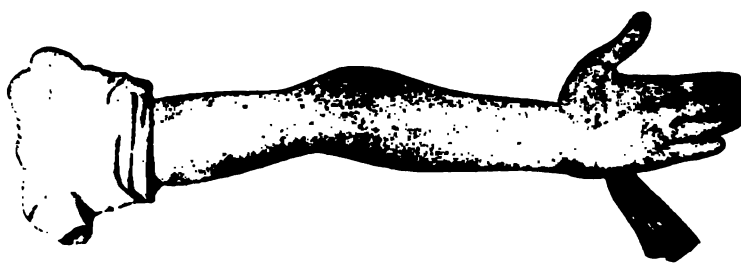
Fracture of the internal epicondyle of the humerus. (Gurilt.)

times occurs in connection with backward dislocation of the elbow. Displacement is not usually marked, consisting when present in the fragment being drawn downward and forward by the muscles

attached to it (Fig. 83). The ulnar nerve has occasionally been involved. The prognosis is much better than in other fractures in this locality.

*Treatment of Fractures of the Condyles.*—In view of the serious disability which results from ankylosis of the elbow, numerous methods of treatment of fractures of the condyles have been suggested. The most popular methods at the present time are probably fixation at a right angle by means of splints, and treatment by acute flexion, or Jones's method. One great advantage of the treatment at a right angle is that if ankylosis occurs in this position the arm will be more useful to the patient than in any other. On the other hand, it is often found that after the treatment by flexion the carrying angle of the arm, so-called, by which I mean the normal wide angle opening outward which the forearm forms with the arm in extension, is obliterated, or even reversed, constituting in the latter case what is known as "gunstock" deformity (Fig. 84). This is due either to the displacement upward of the

FIG. 84.



Supra-condyloid fracture: gunstock deformity. (Stimson.)

internal condyle or to a tilting inward of the entire articular surface. Allis maintains that by treatment of the forearm in full extension the carrying angle is better preserved and gunstock deformity more surely guarded against than by treatment at a right angle, and my experience with this method has been most favorable. If there is no tendency to displacement of the fragments, the flexed position of the arm will usually be found most satisfactory. The fragments should be first carefully reduced, usually under anaesthesia. The dressing is the same as that described for supra-condyloid fracture, consisting of a primary roller, taking in the hand, forearm, and arm, the application of a well-padded anterior angular splint extending as high as the axilla and beyond the tips of the fingers, and perhaps with the addition of a posterior moulded gutter over the elbow (Fig. 77). If the treatment in the extended position be chosen, careful attention should be paid to see that ankylosis does not take place in this posi-



at the expiration of a couple of weeks it would be advantageous to change the position to that of a right angle, and to continue in this position until union is complete, which will usually be at the expiration of four weeks. A plaster cast applied to the arm is held at a right angle may be used to take the place of the anterior angular splint, or this dressing may be applied with the arm in extension if that position be chosen. Passive motion should be begun at the expiration of three weeks, being careful not to apply it vigorously as to disturb the position of the fragments, as injudicious manipulation probably increases the deposit of callus, and thus limits further the motions of the joint.

*Treatment by Acute Flexion—Jones's Method.*—Jones, of Liverpool, was the first to point out that in the position of acute flexion

FIG. 85.



Dressing for fracture of the condyles of the humerus in acute flexion.

at the elbow the fragments were easily maintained in their proper position. Jones's original method consisted in slinging the hand to the neck by a bandage, without further fixation, and maintaining this position for about three weeks, when, if union was sufficiently established, it was gradually lowered. His method has been modified by Dr. J. C. Smith, of Boston, and others, the principle, however, of acute flexion being the same. By binding the forearm and arm together with strips of plaster additional fixation is obtained. Fig. 85 shows a modified dressing for treatment in this position. This method has been extensively tried, and has met with almost universal approval. The tendency to gunstock deformity is largely, if not wholly, overcome, and if passive motion be begun sufficiently

early the functions of the joint are rapidly restored after the dress is discontinued.

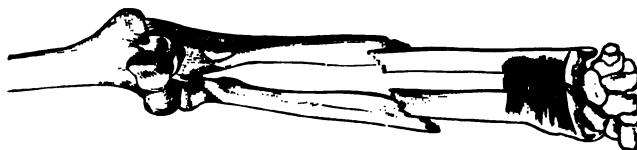
In all fractures of the lower end of the humerus passive motion and massage must be continued for a considerable period after the removal of the splints and dressings. Although the function of the joint may appear considerably impaired at first, improvement will continue for several weeks or months, and the surgeon should not therefore feel discouraged even if there appears to be considerable impairment of motion when the dressings are first removed.

**Compound Fractures of the Humerus.**—In compound fracture of the head and anatomical neck primary excision is usually a preferable form of treatment. In compound fractures of the shaft of the humerus fixation may be secured by silver splints, silver wire, or other forms of suture. The treatment does not differ from that of compound fracture of other bones. In compound fracture of the condyles of the humerus and of the elbow-joint, excision, complete or partial, will often be required, fixation being maintained by means of splints for several weeks, at the end of which time the splints must be removed and passive motion and exercise instituted. The usefulness of the arm can usually be well preserved, although there may be considerable ankylosis; the latter is less likely to result if there has been a free removal of bone and passive motion has been instituted early.

**Fractures of the Bones of the Forearm.**—Either of the bones of the forearm may be broken independently of the other in any portion of its course, or both bones may be broken at the same time by the same violence. Any of the ordinary causes of fracture may be present, viz., direct or indirect violence and muscular action, but the latter is very rarely met with as the sole cause.

**Fracture of the Radius and Ulna.**—The radius and ulna are frequently the seat of simultaneous fracture. The break usually occurs in the middle or lower third of the arm (Fig. 86). When broken by

FIG. 86.



Fracture of the bones of the forearm in the middle third. (Dennis.)

direct violence the lines of fracture are usually parallel; when by indirect violence, the radius commonly gives away at a higher level than the ulna. In children the fracture is very often of the incomplete, or green-stick, variety.

**SYMPTOMS.**—These are those common to fractures in other locations, namely, deformity, mobility, crepitus, swelling, etc. The deformity may consist in a longitudinal or transverse displacement, or angulation at the seat of fracture, especially in the green-stick variety. Overriding may be present in one bone alone. In fractures above the insertion of the pronator radii teres the upper fragment of the radius is likely to be supinated by the action of the biceps, as pointed out by Lonsdale. The ends of the two bones may be displaced toward each other, causing obliteration of the interosseous space. Sloughing or gangrene may occur as a result of the original injury or in consequence of tight bandaging or prolonged pressure. As a result of pressure-sloughs the tendons of the fingers may become much contracted.

**PROGNOSIS.**—This is good in the majority of cases. In some cases in which the deformity has not been properly reduced union may take place with marked angular or rotatory deformity, or the interosseous space may be encroached upon, or even obliterated, the two bones being fused, and supination and pronation abolished (Fig. 87). Non-union is met with rather frequently in the forearm.

**TREATMENT.**—Reduction is effected by extension, counter-extension, and manipulation, the forearm being flexed upon the arm to relax the muscles arising from the humerus. In children, in whom green-stick fracture is very common, the angular deformity must be accurately corrected, and the fracture will often, though not necessarily, be rendered complete in so doing. If there be much swelling or contusion of the soft parts, the forearm may be enveloped for a few days in a layer of lint saturated with one of the usual sedative lotions, as lead-water and laudanum, or lead-water and alcohol. Two straight splints, well padded, are necessary. The palmar splint should be long enough to extend from the bend of the elbow to a little beyond the tips of the fingers; the dorsal splint need not be so long, but should extend from the tip of the olecranon process to just below the wrist. The splints must be wide enough to prevent the encircling bandage compressing the forearm laterally, and thus diminishing the interosseous space. Some surgeons prefer to use two long splints of equal length, while others apply the long splint to the dorsal and the short splint to the palmar surface. In any event careful padding

FIG. 87.



Angular displacement and union between the bones in fracture of the radius and ulna. (Stimson.)



must be employed to prevent injurious pressure, as pressure-sloughs are readily formed, but slow to heal, and if the tendons be involved irreparable damage may be inflicted. The splints should be applied in the position in which the arm is to be kept during treatment, and in my experience the position which gives the best results is that of full supination. As has been pointed out, the upper end of the radius is often supinated by the action of the biceps muscle, and it is easier to put the lower fragment in a corresponding position of supination than to overcome the action of the biceps muscle. Cases of crossed union have occurred in which the ulnar fragment united to the radial fragment. Loss of rotatory power may be due to failure to bring the bones into the same position, the hand being prone or in the semiprone attitude, when the upper end is supinated to the greatest possible degree. It is claimed by those surgeons preferring the semiprone position that the supine attitude is irksome, but patients seldom complain of this in my experience. It is but fair to say, however, that many excellent results are obtained in the semiprone position.

The splints having been adjusted and held parallel by an assistant, and care being taken that the palmar splint if applied when the forearm is extended does not press upon the brachial artery at the bend of the elbow when the forearm is flexed, the bandages are then applied, leaving the tips of the fingers and the phalanges of the thumb uncovered (Fig. 88). As a preliminary step the splints are sometimes surrounded by two or three broad strips of adhesive plaster under the bandage, to prevent their slipping. If this is done, the straps should not be tightly drawn, as they are inelastic. A primary roller should never be applied, as it diminishes the interosseous space and may cause injurious constriction, or even gangrene if subsequent swelling occur. In children, in whom the splints are liable to become misplaced, an anterior angular splint can with advantage be substituted for the straight palmar splint, as it fixes the elbow and is easier held in position. The forearm is supported in a broad handkerchiefsling, which gives even support. The dressing must be changed the second day, and again in two days, after which it may be renewed twice a week until union is firm, which will commonly occur at the end of four weeks. Passive motion should be begun at the end of three weeks, and con-

FIG. 88.



Dressing for fracture of both bones of the forearm.



sists in gentle supination and pronation, with flexion and extension of the wrist and fingers.

**Simultaneous Fracture of the Humerus and Bones of the Forearm.**—This requires some modification of the dressing. If the fracture of the humerus be in its middle or lower portion, an anterior angular splint, with a shoulder-cap, and a short posterior splint to the forearm, may be efficient; or it may be necessary to use the internal angular splint, the semiprone position of the forearm being, of course, adopted in this case. These fractures are liable to be attended with much contusion and swelling of the soft parts, and the union may be delayed in one or all of the bones.

**Fractures of the Radius.**—These include fractures of the head, the neck, and the shaft of the bone, fractures of the lower end, and separation of the lower epiphysis.

**FRACTURE OF THE HEAD OF THE RADIUS.**—This is a very rare condition, and is usually associated with dislocation of the elbow, or fracture of the lower end of the humerus or upper end of the ulna, especially the coronoid process. The fracture may extend to the neck of the bone, it may split off a portion of the head, or it may be incomplete (Fig. 89). The cause may be direct violence, as a blow, or indirect force, as a fall upon the hand or a wrench of the forearm, causing violent abduction.

**Symptoms.**—These are sometimes obscure and difficult to separate from fractures of the neck of the radius. There may be loss of rotation of the upper fragment, which can sometimes be palpated, and crepitus. The function of the radio-humeral joint may be permanently impaired.

**Treatment.**—This consists in the application of an anterior angular splint, to be worn for four weeks; or the elbow may be fixed in the position of a right angle by the application of a plaster-of-Paris bandage, including the hand and forearm, and extending up to the axilla. Excision has been practised with good results both as a primary and a secondary measure.

**FRACTURE OF THE NECK OF THE RADIUS.**—The causes of this fracture are the same as those of fracture of the head of the bone, and the symptoms are very similar. It very rarely occurs without fracture of the head. Separation of the upper epiphysis is also very rare.

**Treatment.**—The treatment of these injuries would be the same as that for fracture of the head of the radius.

FIG. 89.



Fracture of the head and neck of the radius. (Dennis.)

**FRACTURE OF THE SHAFT OF THE RADIUS.**—The radius is more frequently broken than the ulna, as it receives the direct impact of force transmitted from the hand. It may be broken by direct violence or by a fall on the palm of the hand.

*Symptoms.*—These consist in pain, loss of power of pronation and supination, deformity, preternatural mobility, and crepitus. The deformity consists in anterior displacement of the upper fragment by the biceps and rotation inward by the pronator radii teres, and drawing of the lower fragment inward toward the ulna by the pronator quadratus and the long supinator; this results in angular displacement inward (Fig. 90). In some cases there is little or no displacement

FIG. 90.



Fracture of the shaft of the radius. (Stimson.)

present. When the hand is pronated and supinated the head of the bone can be felt to remain motionless.

*Treatment.*—In this case, as in fracture of both bones of the forearm, the supine position is preferable for the reasons previously given. Reduction of the displacement is facilitated by flexion of the arm and adduction of the hand. A long anterior and a short posterior splint are then applied in exactly the same manner as for fracture of both bones of the forearm (Fig. 88). Care must be taken that the fragments do not fall inward toward the ulna, and thus diminish the interosseous space. The splints are retained for about four weeks, at which time union is usually firm. The results of treatment are generally very satisfactory, although non-union may occasionally occur.

**FRACTURES OF THE LOWER END OF THE RADIUS.**—The common fracture in this locality is the so-called Colles's fracture, which occurs from a half inch to an inch and a half from the articular end of the bone, and which is of very frequent occurrence. Other injuries of more or less theoretical interest consist in separation of the anterior or posterior lip of the articular surface of the radius, the latter being known as Barton's fracture. In children we quite frequently have separation of the lower epiphysis. The cause of these fractures is usually violence transmitted through the carpus by a fall upon the palm of the hand. The mechanism of their production has



PLATE II.



Skiagraph of a fracture of the lower end of the radius.



assigned to a cross-breaking strain by overextension and traction on the anterior radio-carpal ligament, to ordinary decomposition of force, and to crushing of the cancellous tissue between the carpus and the diaphysis. It is probable that one or other of the last mentioned is usually the correct explanation. The fracture may be transverse or oblique from before backward. The lower fragment is quite frequently comminuted, and not infrequently impaction exists between two fragments; the styloid process of the ulna and the internal ligament are often injured. The triangular cartilage may be injured.

*Symptoms.*—The symptoms of fracture of the lower end of the radius are usually the characteristic deformity, pain, disability, and sometimes mobility and crepitus. The deformity consists in a backward displacement of the lower fragment, producing a prominence on back of the hand, and another prominence upon the palmar surface a little higher up, which is due to the lower end of the upper fragment (Plate II.). The hand is inclined to the radial side, due to the

FIG. 91.



Deformity in Colles's fracture. (Stimson.)

weakening of this bone, and the styloid process of the ulna is prominent on the palmar surface. This deformity is known as the "silver fork" deformity, from its resemblance to an old-fashioned silver fork (Fig. 91).

*Diagnosis.*—This can be readily made in cases in which deformity is marked. The only injury with which it could be confused would be backward dislocation of the wrist, which occurs very rarely, or a fracture of the epiphysis, which, of course, can occur only in children. From dislocation it may be distinguished by the fact that crepitus is absent in dislocation, and deformity does not tend to recur once reduced. From separation of the epiphysis it is distinguished by the fact that crepitus is softer in the latter case, and the lower end of the radius forms a marked angular projection on the dorsal surface. Crepitus and mobility may be very inconspicuous in cases in which impaction is present. In such cases the diagnosis must rest upon the presence of deformity, localized tenderness, etc.

*Treatment.*—In the diagnosis of fracture of the lower end of the radius anaesthesia is a great aid where there is any doubt as to the nature of the injury; at the same time by its use the reduction of the fracture is greatly facilitated. Perfect reduction of the fragments is very essential to a satisfactory result. The manipulations by which this is accomplished consist in grasping the forearm above the seat of fracture with the left hand and the patient's hand with the right, and making forcible hyperextension by bending back

FIG. 92.



Bond's splint.

the hand; this manœuvre is followed by sudden and forcible flexion, by which means the lower fragment is usually brought downward into position; or the forearm may be held, and counter extension made by an assistant while the surgeon places his thumb on either side of the dorsum of the wrist, and applies the palmar surface of the fingers of each hand to the under side of the patient's hand, and then makes forcible hyperextension, followed by flexi-

FIG. 93.



Position of compresses in Colles's fracture

bringing the fragment downward and forward into place. Where impaction is present it may be necessary to manipulate the fragments forcibly until this is broken up before reduction is accomplished.

The dressing consists in placing the hand upon a well-padded Bond splint (Fig. 92), first applying two compresses of lint, the dorsal one over the upper end of the lower fragment, and the palmar compress over the lower end of the upper fragment (Fig. 93), the hand being in the supine position. The bandage is applied in such a manner as to leave the fingers free (Fig. 94), and the patient should be encouraged to move them frequently, as by this means trouble-



ness and ankylosis will be avoided. In place of the Bond two straight splints may be used, the longer of which is upon the dorsal surface of the forearm, extending from the

FIG. 94.



Dressing for fracture of the lower end of the radius.

the tips of the fingers, and the shorter one upon the palmar extending from the elbow to the wrist, the forearm being in a sling, with the hand inclined to the ulnar side. The should be left free (Fig. 95). The anterior splint may be dis- with at the end of a week, a pad being applied on the palmar over the seat of fracture. In most cases satisfactory re- be obtained by the use of the dorsal splint alone, as there y little tendency to recurrence of the deformity when once orily reduced. At the same time I do not consider that an be safely dispensed with altogether, as is recommended surgeons. Union is firm at the end of four weeks, at which dressings should be removed, and massage and passive motion upon. The functional results are usually good, although eformity frequently persists in spite of the greatest care in

FIG. 95.



Dressing for Colles's fracture with a long posterior and a short anterior splint.

it; it is due in many cases to crushing or comminution of the ts. The most frequent variety of deformity is protrusion of oid process of the ulna at the anterior surface of the wrist. le past fifty, especially of a rheumatic or gouty diathesis,

**FRACTURE; REVERSED COLLES'S FRACTURE.**—These various names have been applied to a rare fracture of the lower end of the radius in which the lower fragment is displaced forward instead of backward, the deformity being the reverse of that seen in Colles's fracture. The line of fracture may be oblique or transverse. There is a prominence on the back of the wrist, which is due, however, to the end of the upper fragment of the fractured radius and the styloid process of the ulna; in front of this is a furrow, marking the normal position of the end of the radius, and on the palmar surface of the wrist the lower fragment can be felt underlying the flexor tendons. There may be marked deviation of the hand to the radial side, accompanying similar deviation of the lower fragment. The force which produces this fracture is probably usually a fall upon the back of the hand while it is in a flexed position.

*Treatment.*—This consists in reduction, the manipulations being carried out so that the force is exerted in an opposite direction to that described for the reduction of Colles's fracture. The arm may then be treated upon a Bond splint, or two straight splints, as directed under the treatment of Colles's fracture, the position of the pads being, of course, reversed.

**SEPARATION OF THE LOWER EPIPHYSIS.**—This injury occurs in children, being quite frequently met with. The deformity is similar to that of Colles's fracture, and consists in an angular projection on the palmar surface of the forearm above the wrist and a corresponding depression upon the dorsal surface. Crepitus is present, but of a soft, cartilaginous nature.

*Treatment.*—The deformity is reduced by extension, counter-extension, and manipulation, and there is little tendency to reproduction. The treatment is the same as that for Colles's fracture. The results are usually very satisfactory.

**Fractures of the Ulna.**—Fracture of the ulna may take place through the olecranon process, the coronoid process, or the shaft of the ulna; or the styloid process may be detached.

**FRACTURES OF THE OLECRANON PROCESS.**—These are rare in children, but are met with quite commonly in adult life. Fracture may occur at any portion of the olecranon, is rarely comminuted, and occasionally compound. The cause is generally a fall upon the elbow, in which the direct violence is aided by the contraction of the triceps muscle (Fig. 96). It has occasionally been broken by muscular action.

*Symptoms.*—These are pain, loss of power of extension of the forearm; deformity, the fragment being drawn up by the action of the triceps muscle, and a space being felt between it and the shaft of the bone (Fig. 97), mobility and crepitus when it is pushed downward until it



comes in contact with the lower fragment. The separation of the upper fragment is greater in cases in which the periosteum and tendinous expansion of the triceps are torn through, and in some cases amounts to but very little. There is often considerable swelling.

FIG. 96.



Fracture of the olecranon with fibrous union. (Park.)

*Prognosis.*—Union takes place in the great majority of cases by fibrous tissue, as in the case of the patella; this is due to the difficulty in maintaining perfect apposition, and probably from the presence of the synovial fluid from the joint between the fragments. The length

FIG. 97.



Skiagraph of fracture of the olecranon. (Roberts.)

of the uniting band varies considerably, and usually disability of the arm is proportionate to the separation of the fragments, being greatest when the upper fragment is far removed from the lower. Occasionally ankylosis of the joint occurs.

*Treatment.*—The arm should be placed in the extended position, to relax the triceps muscle, upon the contraction of which the dis-

placement of the upper fragment depends. A straight splint should then be applied to the anterior surface of the arm, extending from the shoulder to the tips of the fingers, a little extra padding being added at the elbow to render it more comfortable, or a very obtuse-angled splint of equal length may be used. A compress of lint should be placed just above the upper fragment, and one or two strips of adhesive plaster applied over it obliquely from above downward, being fastened to the splint (Fig. 98). The splint is then bandaged

FIG. 98.



Adhesive strap applied to draw the fragment downward.

to the arm from the fingers to the shoulder, figure-of-eight tu being employed over the elbow to further assist in drawing down upper fragment (Fig. 99). This dressing should be renewed at quent intervals at first, and passive motion instituted at the end

FIG. 99.



Fracture of the olecranon dressed in the extended position.

two or three weeks, the fragments being held firmly in position wh it is practised. In the majority of cases a good result will be obtain by this method. It has been suggested to use Malgaigne's hooks this fracture, or to cut down and wire the fragments. I have re sorted to the latter operation in a case of non-union, and secured fir bony union. In cases of compound fracture the fragments should be united by suture.

**FRACTURE OF THE CORONOID PROCESS OF THE ULNA.**—This is a very rare form of fracture. It usually accompanies dislocation, the process being broken off by being driven against the trochlea. It may also result from falls upon the hand or violent muscular action.

y roller applied from the tips of the fingers to the shoulder. An anterior angular splint is then applied, and the dressings retained for a few weeks, being changed at the usual intervals.

**FRACTURE OF THE SHAFT OF THE ULNA.**—This is usually due to direct violence from a fall or a blow. Displacement depends upon the direction of the fracturing force rather than upon muscular action. The radius acts as a splint and prevents overlapping, and if no displacement is present the fracture may easily escape detection. Non-union occurs much more frequently than in the radius.

*Prognosis* is ordinarily very good.

*Treatment.*—The deformity should be reduced by manipulation, being taken that the interosseous space is not encroached upon. The dressing consists of a long anterior splint and a short posterior splint. The anterior splint is identical with that used for fracture of both bones of the forearm and the shaft of the radius (see Fig. 88).

**FRACTURE OF THE STYLOID PROCESS OF THE ULNA.**—This is usually caused by direct violence without other injury; it is very frequently associated with fracture of the lower end of the radius, and is the result of its being torn off by tension upon the internal ligament.

*Symptoms.*—These are pain, swelling, crepitus and mobility of the styloid process, which follows the movements of the hand.

*Treatment.*—By placing the hand in the adducted position the styloid process is brought into contact with the shaft of the ulna. A dressing, which favors adduction, can then be applied, with a bandage over the fragment. Union may be fibrous.

**FRACTURE OF THE CARPAL BONES.**—Simple fracture of the carpal bones occurs with great rarity. Their small size and shape offer little chance of fracture except by direct violence, and even this rarely produces fracture, and then it is usually of a compound nature. Flexion or extension of the carpus may, however, cause fracture.



**TREATMENT.**—Simple fractures demand reduction of deformity if present, and fixation on a palmar splint for three weeks. Compound fractures are often of a nature to demand amputation from injury to the soft parts and the rest of the arm. If amputation can be avoided, removal of loose fragments and foreign bodies, and, after dressing, fixation upon a palmar splint are indicated.

**Fracture of the Metacarpal Bones.**—These fractures are not very common. The second, fourth, and fifth metacarpals are the most frequently broken. The cause is commonly indirect violence, as in striking with the clenched fist—a very common cause—the force being transmitted from the knuckles, or direct violence from a blow, a fall, or a crushing injury. Fractures of the metacarpus are rare in children. Separation of the epiphysis of a metacarpal bone has been reported in at least nine cases (Poland), but this is only possible under twenty years of age. The deformity in fracture of the metacarpal bones when present is usually backward, a prominence being felt on the back of the hand (Plate III.). Mobility and crepitus can usually be elicited. Movements are painful, and the hand is often very much swollen. Not infrequently the patient does not apply for treatment until several days or even weeks after the injury.

**TREATMENT.**—The deformity should be corrected, if present, by extension to the corresponding fingers and pressure upon the fragments. A straight palmar splint, wide enough for the whole hand to rest upon, and extending from the middle of the forearm to the tips of the fingers, is then applied, the palm of the hand being filled with extra padding. A compress is placed over the seat of fracture, and a bandage applied over all (Fig. 100). If there is strong tendency to

FIG. 100.



Dressing for fracture of a metacarpal bone.

overriding, extension may be made by strips of adhesive plaster applied to the corresponding finger and running thence to a peg or nail in the end of the splint, the wrist being first fixed to the splint by adhesive straps or by bandaging. Union is usually firm at the expiration of three weeks.

*Compound fractures* of the metacarpal bones are often associated with extensive injury to the soft parts, and as a consequence may



11

12



PLATE IV.



Skiagraph of fracture of the proximal phalanx of the ring finger.

demand amputation. Where at all feasible, attempts should be made to preserve the hand, even when large fragments of bone have to be removed.

**Fractures of the Phalanges of the Fingers.**—These are quite common as a result of crushing injuries, and even incised wounds, in which case they are compound, often involving several fingers. Simple fractures are less common. The finger is sometimes torn entirely off by being caught in machinery.

**SYMPTOMS.**—These are mobility and crepitus, and sometimes deformity (Plate IV.), especially in the cases in which the fracture is compound as a result of direct violence.

**TREATMENT.**—In simple fractures this consists in the application of a narrow splint, extending from the end of the finger well up into the palm or wrist, to which may be added a short dorsal splint of equal width, extending as high as the knuckles (Fig. 101). Lateral

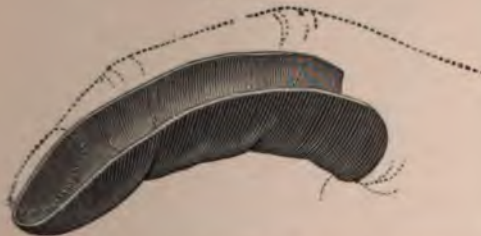
FIG. 101.



Dressing for fracture of the phalanx with anterior and posterior splints.

splints can be used to overcome lateral deformity, or a gutter moulded from pasteboard or felt may be fitted to the palmar surface of the finger (Fig. 102). For the thumb, a moulded pasteboard splint,

FIG. 102.



Moulded splint for fracture of the phalanx. (Hamilton.)

embracing the outer side of the thumb and extending over the thenar eminence as far as its base, will be comfortable and efficient. Union is firm in three weeks. *Compound fractures* of the phalanges often demand amputation, and it is usually recommended to save as much as possible of the fingers. If necrosis occurs, fragments that are



necrosed will require removal, and subsequent amputation may be necessary.

**Fractures of the Femur.**—Fractures of the femur constitute about 6 per cent. of all fractures. They occur at all ages, fractures of certain portions of the bone being more common at different periods of life. Fractures of the neck of the femur are extremely common in elderly people, but occur with great rarity in children. Fractures of the shaft occur with considerable frequency both in children and adults. Fractures of the lower extremity are met with during adult life. For purposes of study, fractures of the femur are divided into fractures of the upper extremity, fractures of the shaft, and fractures of the lower extremity.

**FRACTURES OF THE UPPER EXTREMITY OF THE FEMUR.**—These include fracture of the neck of the femur, separation of the upper epiphysis, fracture of the great trochanter and separation of its epiphysis.

Fracture of the head of the femur has been observed in connection with dislocation, but is extremely rare.

FIG. 103.



Fracture through the neck of the femur  
(*F. subcapitalis*). (Kocher.)

*Fractures of the Neck of the Femur.*

—Fractures of the neck of the femur may be divided into those within and those without the capsule of the joint, or intracapsular and extracapsular fractures.

*Intracapsular* fractures occur almost exclusively in persons advanced in years, especially in the female sex. In a large number of cases it is probable that the line of fracture is not entirely within the capsule. The fracturing force is often of very mild or insignificant nature; thus slight falls on the trochanter, on the knee, turning in bed, and twisting of the thigh in a person advanced in years may be attended by fracture of the femur within the capsule. The line of fracture may be transverse or oblique, and the fracture is not infrequently impacted, the lower fragment being driven into the substance of the head of the bone (Fig. 103).

The *symptoms* consist in deformity, pain, loss of power in the limb, and, where impaction is not present, mobility and crepitus. Pain is greater in cases in which impaction is not present, and is accompanied

and increased by muscular spasm and relieved by extension. The loss of power is usually a prominent symptom, although, owing to impaction, it may not be complete. Mobility and crepitus are present only in cases in which impaction is absent or in which it has been broken up by injudicious handling. Shortening is usually present, perhaps slight at first, often increasing after a few days or weeks, and varies from a half to two inches. Shortening is measured from the anterior superior spine of the ilium to the internal malleolus, or to the adductor tubercle of the femur. It is due to alteration of the angle of the neck and shaft, or to overlapping. The shaft is acted upon by the glutei muscles, the pectineus, and the adductors, as well as the psoas, iliacus internus, and obturator externus muscles. In addition to the shortening, as measured from the anterior superior spine, the trochanter is elevated. This can be determined by its relation to Nélaton's line, which is drawn from the anterior superior spine of the ilium to the tuberosity of the ischium. Normally, this crosses at or above the tip of the great trochanter, and in fracture of the neck,

FIG. 104.



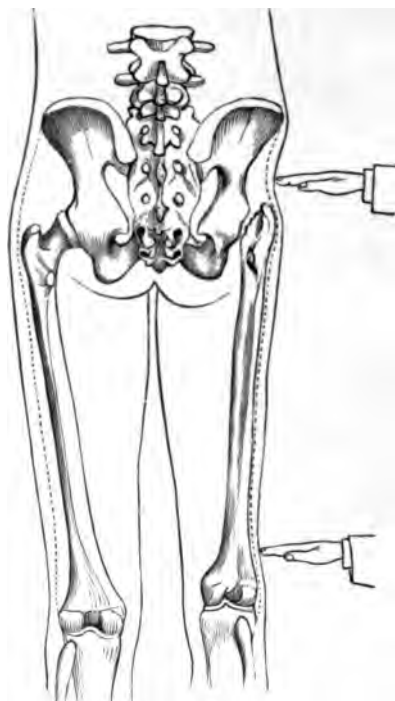
Bryant's ilio-femoral triangle, for diagnosis of fracture of the neck of the femur.

owing to the drawing up of the bone, the trochanter lies above the normal line. The elevation of the trochanter may also be detected by the application of Bryant's measurement, which is the distance from the tip of the trochanter to a vertical line dropped from the anterior superior spine of the ilium, which is compared with the same measurement on the sound side, and any shortening thus estimated (Fig. 104). As a result of shortening there is relaxation of the fascia lata, as pointed out by Allis, which is most conspicuous between the crest of the ilium and the trochanter major, as estimated by pressing the tips of the fingers between these two bony points (Fig. 105). Additional deformity is manifested by eversion of the foot, leg, and thigh, due in part to the action of the external rotator muscles, and in part to the action of gravity, the centre of gravity lying to the outer side of the centre of the limb. When mobility is present the trochanter can be felt to rotate in a shorter axis than on the opposite side. There can also be felt a

sense of resistance below Poupart's ligament in the outer portion of Scarpa's triangle, as pointed out by Hennequin, probably due to angulation at the seat of fracture.

*Prognosis.*—This in intracapsular fracture is not good, so far as the functional result is concerned; indeed, in very aged persons death

FIG. 105.



Allis's method of testing the tension of the fascia lata. (Roberts.)

from exhaustion and hypostatic pneumonia is not uncommon. This class of patients bears confinement to bed very badly, and in such cases it is very frequently necessary to disregard the local injury and to get the patient up and around, in order to prevent a fatal termination. Even under more favorable conditions bony union may be lacking; and when obtained it is often accompanied with disability of the limb. Where the line of fracture extends to the bone beyond the neck the chances of bony union are increased; when entirely intracapsular, owing probably to deficient vascularity, the presence of synovial fluid, and imperfect coaptation, non-union is usually the result. An exception to this may be made in cases in which impaction is present; and all examination and manipulation, therefore, should be of the gentlest nature, to avoid breaking up an

impaction which may offer the patient the only chance of ever obtaining a useful limb. Pain and weakness of the limb, and limping, are usually persistent after repair, locomotion being conducted with the aid of a crutch or cane.

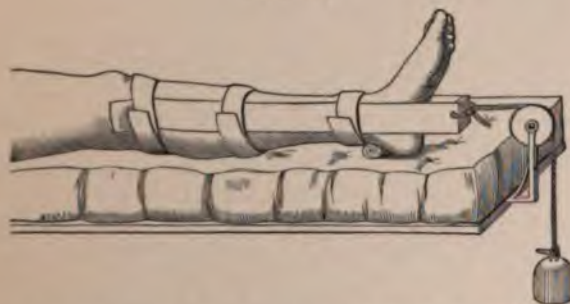
*Treatment.*—In all cases in which it is feasible attempts should be made to secure bony union. This, of course, requires confinement to bed and the application of fixation apparatus, and in a considerable proportion of cases cannot be carried out, or is so badly borne that it must be abandoned, and the surgeon's attention directed to the general health rather than to the local injury. Even in such cases I have occasionally seen good results from confinement to bed alone for three or four weeks without retentive dressings.

In dressing these fractures the patient should be placed in bed



upon a firm mattress, and an extension apparatus made from adhesive plaster should be applied to the leg, extending as far as the knee-joint. The extension apparatus is constructed by taking a piece of adhesive plaster two and a half inches in width, and long enough to extend from the outer side of the knee to four inches below the sole of the foot, and from this point back to the inner side of the knee; in the centre of this strip is placed a block of wood, two and a half inches wide and four inches in length, with a perforation in its centre; the block and the inner surface of the strip on each side are next faced with a similar strip of adhesive plaster to a point about an inch above each malleolus; a few straps are next wound around the wooden block to fix the previously applied straps; the strip of plaster is next warmed and applied to the sides of the leg and held in position by three strips of adhesive plaster carried around the leg at intervals (Fig. 106), and the plaster is made additionally secure by

FIG. 106.



Adhesive plaster extension apparatus applied to limb. (Ashhurst.)

the application of a roller bandage applied to the foot and leg and carried up to the knee. Through the perforation in the block or stirrup is fastened a cord which passes over a pulley attached to the bed, and to this cord is attached the extending weight. The extension apparatus being applied, lateral support is given to the leg and thigh by sand-bags applied on either side; the outer sand-bag should extend from the foot to the axilla, and the inner one from the foot to the groin. A weight of five or ten pounds is attached to the extending cord, and the lower feet of the bed should be raised on blocks a few inches high to prevent the patient slipping down in bed; a pad of oakum or cotton should also be placed under the tendo-Achillis to relieve the heel from pressure. This dressing is kept in place for from four to six weeks, and if union has occurred the patient is kept in bed for a few weeks longer and is then allowed to be about, using crutches.



Where confinement to bed is attended with failure of health or alarming symptoms the patient must be gotten up in a chair, or even on crutches.

Some surgeons have employed Thomas's hip splint in the treatment of this fracture, and claim by this method to secure greater fixation than is possible by that previously described. This splint consists of a long main piece or stem, with cross-bands, which sur-

FIG. 107.



Skiagraph of an extracapsular fracture of the femur.

round the chest, the thigh, and the calf. It is fitted to the patient's back on the side of the fracture, and after having been carefully padded is fastened by a bandage, and in some cases traction secured by the application of adhesive bands applied from the thigh and fastened around the band on the calf. By this means it is claimed that all motion at the seat of fracture is avoided, the patient can be easily handled, and shortening and spasm effectually overcome. The splint should be kept on for from six weeks to two months after the

appearance of pain, and the patient should remain in bed for a month longer after the appliance has been removed.

The *operative treatment* consists in suturing, pegging, or nailing fragments together; which has its proper field in the young and middle-aged, when union by other measures is not to be attained.

*Extracapsular Fractures of the Neck of the Femur.*—In these fractures the line of separation involves the lower portion of the neck and the trochanter (Fig. 107), or the neck and the upper portion of the shaft. They occur usually in consequence of the application of considerable force to the region of the great trochanter, or violence admitted as the result of a fall upon the foot or knee. They are sometimes comminuted, and may be impacted, the neck being driven into the trochanter and shaft. Repair is effected by means of callus, which is often very abundant (Fig. 108).

FIG. 108.



Exuberant callus in extracapsular fracture of the femur.

The *symptoms* of this fracture are very similar to those of intracapsular fracture; indeed, it is often impossible to diagnose between

them. In the case of extracapsular fracture the deformity is usually

FIG. 109.



Fracture of the neck of the femur, with splitting of the great trochanter. (Stimson.)

greater, the shortening varies from one-quarter of an inch to two or three inches. The trochanter may be split, the immediate shortening is liable to be greater than in intracapsular fracture (Fig. 109), and eversion is usually present, except when the fragments are impacted, in which case the foot may be inverted.

*Diagnosis.*—In either intracapsular or extracapsular fracture of the femur the diagnosis is often confused with that of posterior dislocation. In dislocation of the hip, which occurs usually from the application of considerable force, the limb is inverted, very much shortened (often to the extent of three or four inches), is rigid, and the deformity is reduced with difficulty, usually only after the manipulation appropriate for that form of dislocation. Dislocation does not recur when once reduced. In fracture, on the contrary, the limb is usually everted, although in cases of impact there may be inversion of the foot; the shortening is not always marked at first, and seldom reaches the same extent as in dislocation; the limb is easily restored to its proper position, and as quickly returns to the everted position when the extending and correcting force is removed. Crepitus is often present, and the trochanter, instead of being prominent, as in dislocation, is rather flattened. The history and age of the patient will usually throw additional light on the nature of the case.

*Fracture of the Neck of the Femur in Children.*—The neck of the femur may be broken in children as well as in persons advanced in years, and in such cases the fracture is usually probably either impacted or green-stick in nature. It is probably more frequent than has been hitherto supposed; indeed, it may be accompanied by very few symptoms, and recovery may be rapid. Later on, however, in such cases it appears that coxa vara is of frequent development, and is attended by the characteristic symptoms and disability associated with that condition, namely, shortening and limitation of movement.

*Treatment.*—The dressing for extracapsular fracture is identical with that employed for fracture within the limits of the capsule, from which indeed it cannot be separated in many cases. In children where it is diagnosed it should be treated in a similar manner; and it



recommended in these cases to follow up the treatment by the application of a traction hip-splint for some months, until the danger of subsequent bending of the neck of the femur is passed.

*Fracture of the Great Trochanter.*—As a rare independent injury, a fracture of the great trochanter of the femur occurs from the application of direct violence, such as a fall or a blow. It may occur in patients under eighteen years, in a fracture of the epiphysis of the trochanter.

*Signs.*—These are swelling in this region, tenderness, and mobility of the fragment, and crepitus. As the fracture does not extend into the shaft or axis of the bone, there is no shortening, the movement of the hip may be free, and locomotion possible.

*Treatment.*—Confinement to bed with fixation of the limb by sand-bags is indicated. Extension is not required for cure, but may be of service if there be much pain from injury to the joint, and is applied as in fracture of the neck of the femur.

*FRACTURES OF THE SHAFT OF THE FEMUR.*—Fractures of the shaft of the femur occur with considerable frequency at all ages, being common, however, under ten years. In children the line of separation is usually more or less transverse; in adults it is commonly oblique.

Rickets, a common disease in children, is certainly a predisposing cause to this fracture. It occurs from direct violence, from indirect violence, or from muscular action.

FIG. 110.



Fracture of the great trochanter of the femur. (Bryant.)

FIG. 111.



Deformity on account of action of the psoas and iliacus muscles and external rotators.

*Signs.*—These are those common to fracture, deformity, motion, and crepitus usually being well marked. The deformity consists in shortening, due to overlapping of the fragments and to angular displacement; this angularity is most marked in fractures of the upper part of the femur (Fig. 111), where the upper fragment is drawn



forward and upward by the action of the psoas and iliacus internus muscles, or outward by the action of the gluteus minimus and obturator internus and quadratus femoris, or a combination of these positions may be present; at the same time the lower fragment is drawn toward the upper. In fractures of the shaft lower down the lower fragment usually lies behind and to the inner side of the upper fragment (Fig. 112); the foot is everted, due to the weight of the

FIG. 112.



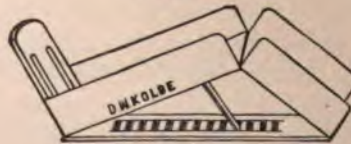
Displacement in fracture of the shaft of the femur.

limb, the centre of gravity of which lies to the outer side of the axis.

*Prognosis.*—It may be said that a good functional result is obtained in the large majority of cases, although, except in the case of children, a certain amount of shortening is inevitable, varying from one-quarter to one and a half inches. As has been frequently pointed out, the two limbs vary slightly in length in the normal individual, so that a slight amount of shortening may be looked upon with complacency.

*Treatment.*—In fractures of the upper third of the femur the principal difficulty arises from the upward and outward rotation of the upper fragment. Usually this is overcome by the dressing to be described. In exceptional cases in which it is impossible to overcome the angular deformity by the usual dressing, it may be necessary to bring the lower fragment into a line with the upper by means of a double-inclined plane or a fracture-box (Fig. 113), the extension

FIG. 113.



Double-inclined fracture-box.

being applied from just below the seat of fracture to the knee, in the line of the upper fragment; or an anterior wire splint, such as was

described by Prof. N. R. Smith, may be bandaged to the limb and the latter suspended.

In the treatment of fractures of the shaft of the femur the dressings are applied to diminish as far as possible the shortening, and to prevent angular or rotatory displacement of the fragments. In dressing these fractures the patient should be placed upon a fracture-bed or an ordinary bed with a firm hair mattress; an extension apparatus of adhesive plaster is applied, and extension is made by a weight attached to this as previously described. Lateral support is given to the limb by the application of two wooden splints—the outer, or long one, extending from the axilla to the foot; the inner, or short one, extending from the groin to the foot. The splints at their upper extremity should be about six inches in width, and at their lower extremity about three and a half inches. The splints are wrapped in a splint-cloth which extends from the foot to the groin, and after this has been placed under the limb the splints are fixed in their proper positions, the short one to the inner side, the long one to the outer side of the limb. Between the limb and the splints are interposed bran-bags: the outer bag should be long enough to extend from the axilla to the foot, the inner one from the groin to the foot. The splints and bran-bags are held in place by five or six strips of bandage passing at intervals under the limb and body and around the splints and bran-bags. The heel is saved from pressure by placing a wad of oakum or cotton under the tendo-Achillis, and after the splints have been brought into place the strips of bandage are firmly tied to secure them, and a weight of ten or twelve pounds is attached to the

FIG. 114.



Fracture of the shaft of the femur with lateral splints and bran-bags. (Ashhurst.)

extending cord. The foot of the bed is raised to prevent the patient slipping downward and to allow the weight of the body to act as a counter-extending force. After the application of the dressings the thigh should be slightly abducted. During the after-treatment of these fractures the surgeon should see that the splints and bran-bags

are kept firmly in place, and that the foot does not roll outward; is accomplished by untying the strips and readjusting the bags then bringing up the splints and securing them in position by fastening the strips (Fig. 114). The extension apparatus usually does require renewal during the course of treatment. The extension apparatus and splints are kept in place for four or six weeks, and at this time union at the seat of fracture is usually quite firm, so they may be removed, and the fracture is then supported by mould pasteboard splints or by the application of a plaster-of-Paris splint for several weeks longer, and at the end of eight weeks it is so arranged as to allow the patient to be up and around on crutches.

Many surgeons, in fracture of the shaft of the femur, prefer to use a *long external sand-bag* and a *shorter internal one*, in place of corresponding long and short splints and bran-bags, and if carefully observed to see that the sand-bags are kept accurately in contact with the limb and body excellent results may be obtained by this form of dressing. After considerable experience with both methods of furnishing lateral support in the dressing of fractures of the shaft of femur, I am well satisfied that angular deformity is less likely to result where the splints and bran-bags are employed.

*Fractures of the Shaft of the Femur in Children.*—A considerable experience in the treatment of fractures of the femur in infants and children has led me to adopt the following line of procedure: in infants or children under eighteen months of age the shortening is usually not marked, and I find that the use of continuous extension is unsatisfactory, from the fact that the child has to be lifted to be nursed, if it is taking the breast, and when the napkin is changed. In these cases the treatment is as follows: the injured thigh is compared with its fellow, and deformity, if present, is noted, and measurements are taken to ascertain if shortening is present. If there is angular deformity or bending of the bone from incomplete fracture this is corrected by manual force; and if the fracture be an incomplete one, in the manipulation necessary to correct the deformity unbroken fibres of the bone often give way, rendering the fracture complete one; this I consider no disadvantage. An anæsthetic may be required if the manipulation causes the patient much discomfort. The limb is next held in the corrected position, and a binders' bandage splint is cut long enough to extend from the sole of the foot to the ribs, and wide enough at its upper portion to include one-half of the body and pelvis, and also wide enough to include one-half of the thigh and leg. This is soaked in boiling water and applied to conform to the outer portion of the body and pelvis and to the thigh and leg, being cut to fit the groin. This is next well padded with cotton wool and then applied to the foot, leg, thigh, and body, and held firm.



in place by the turns of a bandage. This splint fixes the knee- and hip-joints. In a few hours, when it has become firm, the patient can be lifted when the bed is changed, or to be nursed, without discomfort or without displacing the fragments. This splint is not changed for a week unless it becomes soiled, and is then reapplied, or a fresh splint is applied in the same manner. The dressing is usually worn for four weeks, and then can be dispensed with, as union is generally quite firm at the seat of fracture by that time. In infants this method of treatment has in my experience given most satisfactory results.

In the treatment of fractures of the femur in children over eighteen months of age I usually apply extension, counter-extension, and lateral support, the dressing being with a few modifications that which is employed in adults for a similar injury. I have found that children of this age bear confinement to bed very well. In the dressing of these cases I consider the use of an anæsthetic essential when the first dressing is applied.

After applying the extension apparatus to the leg two pieces of binders' board are next cut, the outer one long enough to extend from the great trochanter to a point a little below the knee-joint; the inner one of sufficient length to reach from the perineum to a point a little below the knee-joint; these should be made to conform to the shape of the thigh, and each should be wide enough to include a little less than one-half of the circumference of the thigh. These splints are next dipped in boiling water to soften them, and are then fitted to the external and internal aspect of the thigh; they are finally padded with a layer of cotton-wadding, and firmly secured to the thigh, while the limb is held in the proper position by an assistant.

After bandaging the pasteboard splints to the thigh, the bandages and the long external and internal splints are adjusted in the manner described for the treatment of this fracture in the adult. A weight of from six to eight pounds will be sufficient for the extension. Some portions of this dressing may require renewal in a few days, but the extension apparatus does not usually require renewal. If the binders' board splints become soiled from the urine or faecal evacuations, they can be replaced by new ones without difficulty. In male children the urine can be passed into a jar or urinal, but in female children the dressings are more likely to be soiled and require more frequent changes. When evacuation from the bowels occur the internal splint and sand-bag are removed, and as the ordinary bed-pan is too large to be slipped under the buttocks, I usually find that a flat tin plate, covered with a piece of muslin, can be slipped under the buttocks to receive the faecal matter.

This dressing is employed for about four weeks, and if union is



firm the extension is then removed, and the moulded binders' board splints are reapplied and allowed to remain for two or three weeks longer, the child being permitted to sit up in bed and move the limb as he desires. At the end of six weeks, if he is old enough to use crutches, he is allowed to go about on these for a few weeks. I never permit these cases to walk upon the injured limb until the expiration of eight weeks, for I have seen cases in which very marked bending of the limb or consecutive shortening occurred from patients being allowed to walk upon the limb at the end of five or six weeks. Refracture of the bone I have also seen occur upon slight provocation when the patient was allowed to walk about before the callus at the seat of fracture was sufficiently consolidated.

The results of treatment of fractures of the femur in children are usually satisfactory. The shortening is generally slight, not more than one-fourth to three-fourths of an inch, and indeed in some cases, especially fractures involving the lower third of the bone, examined a few months after the injury, the injured limb by measurement may be found to be slightly longer than the sound one. This may be accounted for, according to Verneuil, by increased growth of the injured bone, due to irritation of the lower epiphysis from the traumatism.

FIG. 115.



Fracture of the lower end of the femur. (Dennis.)

Angular deformity is usually not present if the deformity was satisfactorily reduced in the early treatment of the case.

**FRACTURES OF THE LOWER END OF THE FEMUR.**—These include supracondyloid fractures, separation of the lower epiphysis, and fracture of one or both condyles.

*Supracondyloid Fracture of the Femur.*—The fracture occurs above the condyles, either at their base or some little distance removed from them. The deformity usually consists in a backward displacement of the lower fragment from the action of the gastrocnemius muscle which arises from it (Fig. 115).

*Treatment.*—This is by the application of extension, splints, and bran-bags, as described for the treatment for fracture of the shaft.

*Separation of the Lower Epiphysis.*—This occurs as a result of great violence in patients under eighteen years. The nature of the violence has usually been the twisting produced by the leg being caught between the spokes of a wheel while in motion. Quite a large number of cases of this injury are on record, in a large proportion of which the fracture has

been compound. The deformity usually consists in a forward displacement of the lower fragment, the upper fragment being displaced posteriorly. The popliteal vessels and nerves are not infrequently injured.

*Symptoms.*—These are the deformity, consisting, as has been said, in a forward displacement of the lower fragment (and with it, of course, the knee), abnormal mobility, and soft crepitus. The end of the diaphysis may be driven through the tissues of the popliteal space. The knee-joint is not usually opened.

*Treatment.*—Anæsthesia will probably be required as a preliminary to reduction. This may be very difficult, but can usually be accomplished by manipulation, which consists in direct pressure and flexion of the knee on the thigh. Open incision may be necessary before reduction can be accomplished. Resection of the end of the diaphysis may be necessary in compound fractures as an aid to reduction, although in many of the latter cases amputation will be called for on account of the injury to the vessels and soft parts. After reduction the application of extension apparatus or of a plaster-of-Paris bandage to the leg and thigh will be indicated.

*Fractures of the Condyles of the Femur.*—The most common cause of fracture of the condyles is a blow or a fall upon the knee. It is possible for one of the condyles to be separated by avulsion. Either condyle may be broken separately, or we may have a T-fracture (Fig. 116). These fractures are not infrequently complicated by injury to the popliteal vessels and nerves.

*Symptoms.*—These may be very slight. In a case recently under my care, in which fracture of one condyle was associated with compound fracture of both bones of the leg, the fragment was turned upon itself, so that the fractured surface presented in the knee-joint. The knee was maintained in partial flexion, and could not be completely extended.

*Treatment.*—Reduction is accomplished by flexing the leg upon the thigh, in combination with traction upon the leg, being careful to avoid such violence as might cause injury to the popliteal nerves or vessels. The after-treatment will depend upon whether the line of fracture runs completely across the longitudinal axis of the bone or merely separates one condyle. In the former case the extension should be applied as in ordinary supracondylar fracture, in combination with the lateral splints and bandages. If the line of fracture involves merely one condyle, the use of a long fracture-box, extending to the middle of the thigh, with

FIG. 116



Intercondylar fracture of the femur. (Stimson.)

a compress over the injured condyle, will be sufficient; or the leg may be encased in a plaster-of-Paris bandage, although I usually prefer to postpone the application of the cast until all swelling has subsided. In the case mentioned above, in which the fragment was turned upon itself, preventing extension, manipulation failed to restore it to its proper position, and I therefore opened the joint and removed the fragment. Fracture of the condyles of the femur may be followed by permanent ankylosis or stiffness of the joint.

**COMPOUND FRACTURES OF THE FEMUR.**—These are not uncommon, especially as the result of railroad injuries, and are associated with so much injury of the soft parts, laceration of the bloodvessels etc., as often to call for immediate amputation. More conservative treatment should be attempted where the main artery of the limb is intact, and where the comminution of the fragments and the contusion and laceration of the soft parts are not such as to forbid attempt to save the limb. In these cases, after thorough sterilization of the wound and the surrounding parts, and removal of detached fragments, it is well to unite the fragments by some form of suture either by heavy silver wire or by silver splints and screws. Free drainage must be provided, and fixation secured either by the application of a plaster bandage, including the whole limb, or of the ordinary extension apparatus. Under these circumstances it will often be possible to avoid amputation and secure a good functional result although perhaps attended by considerable shortening.

*Ambulant Treatment of Fractures of the Femur.*—To avoid the long confinement to bed, with its enforced idleness and danger to health, some surgeons, especially in Germany, have recommended the application of a plaster-of-Paris dressing, which will permit the use of the limb by the patient. Simultaneously these surgeons also assert that the process of repair is hastened and muscular atrophy and joint stiffness avoided. The method of application is as follows: the leg and foot are first included in a strong plaster-of-Paris cast, which is applied directly to the skin, extending from the metatarsal bones to the knee. The foot is first padded with a number of layers of cotton and is kept at a right angle to the leg while the plaster is setting. Extension is made from the plaster cast and counter-extension from the chest, until the deformity is reduced and the limbs are of equal length. The plaster bandage is then continued up the thigh to the tuber ischii and gluteal fold, and around the lower portion of the abdomen and the pelvis on the affected side as high as the anterior superior spine, strips of veneer or basswood being incorporated in it to strengthen it. Extension and counter-extension are kept up until the bandages are firm. Beginning the following day—



patient is allowed to walk, at first with crutches, later with a and finally bearing his weight without support upon the cast.

For children and young adults a long hip-splint, with a foot-piece and with extra support around the thigh, or Thomas's splint, may be applied after union is effected, and the patient furnished with crutches and a high sole on the opposite shoe (Fig. 117). Children bear confinement to bed very well as a rule, so that I do not think there is enough to be gained by underbalance the risk of this measure, however small it may be.

**Fracture of the Patella.**—Fracture of the patella is an accident of young adult and middle age and is most frequent in the male sex. The usual cause is muscular action, the patella being broken transversely by the contraction of the quadriceps femoris muscle while the limb is in the position of partial flexion, as a result of a fall, in an effort to maintain the erect posture. It may be broken by direct violence. The direction of the fracture may be transverse, vertical, or oblique; the

fracture is usually simple, but may be compound or comminuted (Fig. 118); in the latter case it is generally the result of direct violence.

**SYMPTOMS.**—These consist in pain and swelling, due in part to extravasation of fluid and blood within the capsule of the joint; separation of the fragments, marked only in the transverse or oblique variety, and in proportion to the extent of laceration of the tendinous expansion of the quadriceps. The separation is due in these cases to contraction of the quadriceps muscle and distention of the joint by synovial fluid and blood. There is marked disability, although occasionally patients are able to walk when compelled to do so; crepitus can be obtained by relaxing the quadriceps muscle and drawing the upper fragment until it is brought in contact with the lower.

FIG. 117.



Ambulant treatment of fracture of the femur by means of Thomas's splint and the plaster-of-Paris bandage. (Warbasse.)

FIG. 118.



Comminuted fracture of the patella.



**PROGNOSIS.**—In fracture of the patella union ordinarily takes place by fibrous tissue; indeed, this is the rule in all cases not treated by operation. The fibrous band varies in length;

FIG. 119.



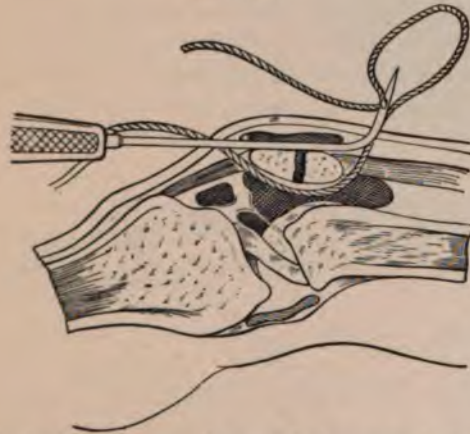
Long fibrous union in fracture of the patella. (Stimson.)

in some cases there is almost no appreciable separation of the fragments, although the union is ligamentous; in other cases the separation may amount to three or four inches; in the latter case the disability is usually marked (Fig. 119). Disability may also depend on rigidity of the joint, due to intra-articular adhesions. In the majority of cases there is some weakness or stiffness of the joint.

**TREATMENT.**—This may be operative or non-operative. The various operative methods are attended with considerable risk, as they nearly all involve incision and opening the joint-capsule. In view of the usual favorable results obtained by non-operative measures, they are only to be recommended where the operator is able to carry out the strictest details of aseptic technique. They consist in open incision, with suture of the fragments with silver wire, or suture of the capsule and periosteum. By these methods all fragments of periosteum which may fall between the fragments and interfere with union can be removed and the joint cleansed of blood and fluid. Other methods are subcutaneous circumpatellar suture, or Barker's operation, and the use of Malgaigne's hooks. In Barker's operation a puncture is made through the ligamentum patellæ; a curved needle is passed under the patella from below upward and brought out above, transfixing the tendon of the quadriceps muscle; it is threaded with heavy silk or silver wire and withdrawn. The needle is then rethreaded, passed through the same puncture above the patella, over the bone, brought out through the same puncture below, rethreaded with the other end of the ligature, and again withdrawn, thus carrying the suture completely around the patella, both ends protruding through the upper puncture; it is then tied with sufficient firmness to bring the fragments into exact apposition, and the ends buried in the wound (Fig. 120). The limb is dressed with gauze and placed on a posterior splint or encased in a plaster cast. The ligature necessarily transfixes the joint, and the operation is therefore attended with the same danger of infection as accompanies the open operation. It does not permit of cleansing of the joint or removal of fragments of periosteum which may fall between the

ments. Excellent results, however, have been obtained by this method.

FIG. 120.



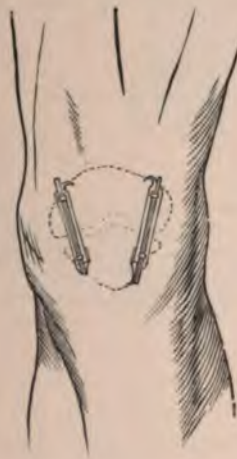
Keen's operation for transverse fracture of the patella by means of a ligature passed around the bone. (Keen and White.)

*Malgaigne's Hooks.*—This method of treatment has been revived in recent years, and when practised, as it should be, with strict aseptic technique, has been attended with very favorable results (Figs. 121, 122). An antiseptic dressing is applied over the hooks, which are

FIG. 121.



FIG. 122.

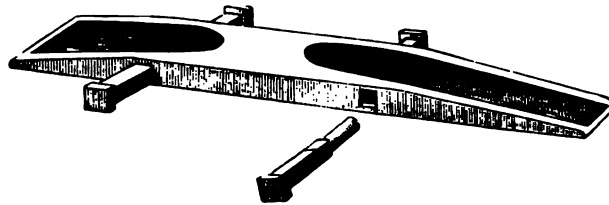


Levi's modification of Malgaigne's patella hooks.

held in position for two or three weeks. After their removal a water-of-Paris dressing is applied for from four to six weeks longer.

*Non-operative* treatment is the method applicable to the majority of cases in private practice in the hands of the majority of practitioners. It consists in the application of a primary roller, including the foot and extending to just below the knee-joint, the leg being in an extended position. The quadriceps femoris is then further relaxed by flexing the thigh upon the pelvis. A straight posterior wooden splint, well padded and of sufficient length to extend from

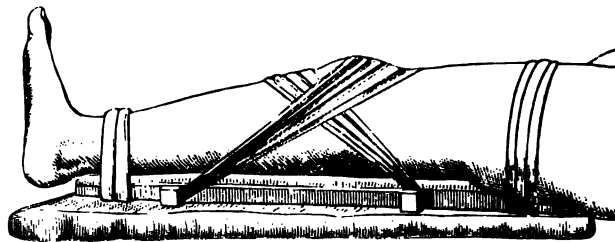
FIG. 123.



Agnew's splint for fracture of the patella.

the middle of the thigh to the middle of the leg, is applied to the posterior surface. The upper fragment is drawn down and fixed by a compress placed above it, and secured by one or two strips of adhesive plaster passing obliquely over it and around the posterior surface of the splint. The lower fragment is treated in a similar manner, compress being placed below it and held by a strip passed obliquely around the splint in the opposite direction to that first applied. The leg and thigh are then bandaged to the splint, figure-of-eight turns being used over the knee to assist in maintaining apposition of the fragments. This dressing is removed and reapplied at intervals

FIG. 124.



Agnew's splint applied.

during the course of treatment. The limb is kept in an elevated position, either in a fracture-box or on an inclined plane, and the dressing maintained for from four to six weeks. Agnew's splint, which consists of a posterior splint provided with pegs (Fig. 123), around which the ends of the strips of adhesive plaster are passed (Fig. 124) may be used instead of the posterior splint.

It is sometimes recommended to attempt to disperse the effusion



joint by massage or the application of a rubber bandage for days, before applying the fixation apparatus described. After removal of the splint at the end of three or four weeks a plaster cast, extending from the middle of the leg to the middle of the thigh, is applied, and allowed to remain for several weeks longer. After removal of the cast massage and gentle passive movement may be practised; or massage may be practised earlier through a fenestrum in the cast, or the latter may be split so as to permit of its daily removal.

Reaction on the upper fragment may be attended by lengthening of the fibrous band, even after union and repair seem fairly complete. The patient should exercise great care in the use of the limb for some months after the fracture.

A laced knee-cap or bandage may be worn during this time.

Fracture is not a very uncommon accident, and the other patella may be broken, usually as a result of the weakness and sense of security in the injured limb. *Isolated fracture* is not attended by much displacement of the fragment, and fixation on a splint, followed by the application of a plaster cast, usually gives good results.

*Compound Fracture of the Patella.*—Compound fracture of the patella calls for active treatment. Thorough sterilization of the wound of the joint should be immediately practised, the joint irrigated, all loose fragments removed, and the remaining fragments secured by silver wire or absorbable sutures.

The wound in the capsule should be closed with catgut; and it is well to provide drainage for a few days by the insertion of a tube into the joint, which may be removed at the end of that time if no symptoms of infection manifest themselves.

The remainder of the skin wound is sutured, the wound covered with a large antiseptic dressing, and the leg maintained in the extended position by the application of a posterior splint or plaster-dressing.

**Fractures of the Bones of the Leg.**—**FRACTURE OF BOTH BONES OF THE LEG.**—Fracture of both bones of the leg occurs quite frequently as a result of direct violence from a blow or a crushing injury, or from indirect violence usually due to a fall. Fracture due to direct violence may occur at any portion of the bone; when the

FIG. 125.



Line of fracture at junction of the lower third and middle third of the tibia. (Park.)



result of indirect violence it usually occurs about the junction of the middle and lower thirds. In the latter case the direction of the line of fracture of the tibia is commonly oblique, from above downward and from behind forward. The fibula, in fractures due to indirect violence, is usually broken at a slightly higher point (Fig. 125). The line of fracture may extend into the ankle-joint (Fig. 126) or into the knee-joint.

*Symptoms.*—The symptoms of this fracture are deformity, mobility, crepitus, pain, swelling, etc. If the line of fracture is transverse, in

FIG. 126.



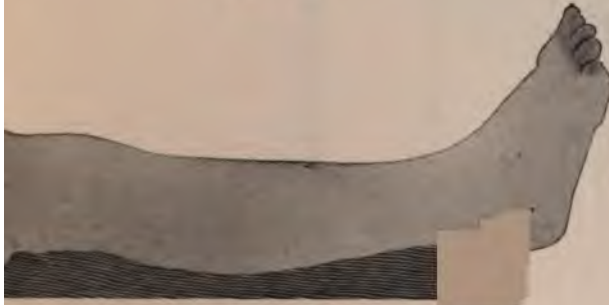
Skiagraph of fracture of the tibia and fibula.

which case it is usually the consequence of direct violence, deformity may be absent. In oblique fractures there will usually be considerable shortening, the lower fragment being drawn upward and backward. Lateral displacement may also be present. The subcutaneous surface of the tibia is easily palpated, and any variation from the normal line is usually readily detected.

*Treatment.*—Many surgeons, after reduction of the fracture by extension and counter-extension, recommend the immediate application of a plaster-of Paris bandage, which extends from the toes to above the knee-joint (Fig. 127). Swelling of the limb may be present when

first seen ; or, if not, is liable to develop shortly afterward. It should be applied at this time, before swelling has occurred, so that constrictions of the limb or annoying pressure-sloughs may not develop. On the other hand, if we wait until swelling

FIG. 127.



Plaster bandage applied to fracture of the bones of the leg.

and before applying the plaster-of-Paris bandage, it must be waited a week or ten days, when the swelling has subsided, as owing to reduction in the size of the limb, fixation will not be complete. My practice in these cases, after reduction of the fracture by extension and counter-extension, aided by manipulation as necessary, is to treat the fracture by placing the leg in a fracture-box padded with a soft pillow, the foot being adjusted at a right angle and secured to the foot-piece by a bandage, and compresses applied between the foot and the foot-board, under the heel,

FIG. 128.



Application of the fracture-box.

at any other point where counter-pressure may be necessary to maintain reduction (Fig. 128). In some cases a subcutaneous section of the tendo-Achillis will be of advantage to overcome marked tilting of the lower fragment due to the contraction of the

FIG. 129.



Suspended fracture-box, with slide on cord by which box can be raised or lowered. (Agnew)

calf-muscles. The fracture-box may be swung to a frame over the bed, allowing the patient to turn slightly from side to side, and thus make the treatment less irksome (Fig. 129). This dressing is of

FIG. 130.



Volkmann's splint for fracture of the bones of the leg.



for about ten days, or until the swelling has subsided, when a *of-Paris* bandage is applied, including the foot and leg, and extending above the knee-joint. This is allowed to remain undisturbed for six or eight weeks, during the latter part of which time the patient can move about on crutches without bearing any weight on the injured limb. At the expiration of that time it is removed, and motion will usually be found to be firm. If any mobility of the joint is present at this time, another cast of the same dimensions may be applied, and allowed to remain for three or four weeks.

Some surgeons prefer other forms of splints until the swelling has subsided, such as Volkmann's splint (Fig. 130); the Cabot posterior splint; and in some cases, in which there is a tendency to shortening, various ingenious forms of traction splints have been applied.

**Fracture of the Tibia.**—The tibia may be fractured at any part of its length, and the upper and lower epiphyses are sometimes separated in early life. In fractures of the upper or the lower end of the tibia the neighboring joints may be involved (Fig. 131). The causes of fracture of the tibia are direct and indirect violence.

Fracture of the shaft of the tibia alone does not usually very marked, the treatment being as a splint to prevent shortening. Fractures near the knee-joint, or extending into it, the symptoms of displacement may be absent or there may be some tilting of the fragments. Effusion into the joint is common and the tibial vessels may be injured. The middle of the tibia has occasionally been broken by violent contraction of the quadriceps. The tip of the internal malleolus is entirely torn off in fracture of the lower end of the fibula. In epiphyseal separation of the upper end of the tibia the internal malleolus loses its normal relation to the foot; the fibula is frequently broken at the same time.

**Treatment.**—The treatment of fracture of the tibia is the same as that described for fracture of the bones of the leg. The prognosis is good except where the joints are involved in the fracture, in which case more or less disability may result.

**Fracture of the Fibula.**—The fibula is commonly broken in its lower third by indirect violence. It

FIG. 131.



Fracture of the upper end of the tibia. (Park.)



may, however, be broken in other portions of its length in consequence of violence applied directly at that point. Fractures of the upper end of the bone may also be due to muscular action or to forced adduction of the leg. In fractures of the upper end of the fibula the upper fragment may be drawn backward by the biceps. The popliteal nerve is sometimes injured. In fracture of the shaft of the fibula, displacement when present consists in a tilting forward of the lower end of the upper fragment.

*Treatment.*—The treatment of fractures of the upper end of the fibula and of the shaft of the fibula consists in the use of a fracture-

box for the first week, or until the swelling has subsided, followed by the application of a plaster cast, or by the application of a plaster-of-Paris bandage immediately, extending from the base of

FIG. 132.



Fracture of the tibia and fibula near the ankle.  
(Hoffa.)

FIG. 133.



Exaggerated deformity in Pott's fracture.  
(Park.)

the toes to above the knee-joint. In the case of fracture of the upper end of the fibula the backward displacement may be overcome by flexing the knee, and then applying a plaster-of-Paris bandage.

*Fracture of the Lower End of the Fibula.*—*Pott's Fracture.*—Indirect violence exerted through the foot is the cause of fracture of the lower end of the fibula, and it may be due to either adduction or

abduction of the foot. Pott's fracture, by which I mean a fracture of the lower fifth of the fibula, attended by laceration of the internal lateral ligament, avulsion of the internal malleolus, or fracture of the outer edge of the tibia, is due to abduction and eversion of the foot (Fig. 132). The external malleolus may be torn off by forced adduction and inversion.

*Symptoms.*—These in Pott's fracture are eversion and backward placement of the foot, with prominence of the internal malleolus, widening of the ankle-joint, with perhaps displacement of the astragalus (Fig. 133). There are increased lateral mobility, tenderness, crepitus over the seat of fracture.

*Treatment.*—The deformity is easily corrected by inversion and extension upon the foot, drawing it forward, but immediately returns when the foot is released. In a few cases in which there was great spasm of the muscles of the calf I have found it of advantage to

FIG. 134.



Dupuytren's splint.

divide the tendo-Achillis subcutaneously. After reduction of the deformity the fracture may be treated by placing the leg in a fracture-box, as described in the treatment of fracture of both bones of the leg, with the addition of two compresses, one above the internal malleolus and the other below the external malleolus, to exert pressure in an opposite direction to that of the deformity. After a week or ten days the plaster-of-Paris bandage is applied. Some surgeons apply the plaster-of-Paris dressing immediately after the injury. Among the other methods of dressing this fracture may be mentioned Dupuytren's splint (Fig. 134), which consists of a straight internal splint, extending from the lower part of the thigh to about six inches below the sole of the foot, which is applied to the inner side of the leg and foot, being heavily padded over the portion which comes in contact with the lower portion of the leg and ankle; the foot and leg are then bound to this in such a manner as to cause marked inversion of the foot, thus correcting the deformity. This dressing is now seldom employed, owing to the pain and discomfort which usually accompany its use. Stimson's posterior and lateral plaster splints may be used from the beginning (Figs. 135 and 136). Union occurs usually without difficulty, being quite firm at the end of a month. The patient should not be allowed to place his weight



upon the foot for six weeks. He may, however, go around on crutches after the plaster bandage has been applied.

*Fracture of the external malleolus*, due to adduction, is accompanied by inversion instead of eversion of the foot. The fragment can easily be felt on the outer side of the foot. Pain, mobility, and

FIG. 135.



Pott's fracture; posterior plaster splint. (Stimson.)

crepitus are also present. The *treatment* consists in the use of a fracture-box or plaster-of-Paris bandage, it being remembered that the deformity is usually the opposite of that in Pott's fracture, the foot being dressed, therefore, in a slightly everted position.

*Ambulant Treatment of Fractures of the Bones of the Leg.*—The object is to apply such a dressing as will enable the patient to use the member in walking, dispensing very shortly with the use of either

FIG. 136.



Pott's fracture; lateral plaster splint. (Stimson.)

crutch or cane, and continuing to use it during the period in which the bones are uniting. The advantages which the advocates of this treatment claim are: the fact that the patient is enabled to be about and to transact his ordinary business; that the general health is not liable to be injured by confinement to bed; swelling is diminished or avoided; muscular atrophy and joint-stiffness are prevented; excessive callus does not occur, and union is hastened.

The treatment as applied to fracture of the leg consists in first

made especially thick over the sole of the foot by means of a series of longitudinal turns. It is closely applied just below the head of the tibia and the fibula, the object being when the patient is up to have the weight supported upon the surface of the leg below the knee-joint, and to a less extent upon the calf. No weight falls upon the foot, owing to the padding which has been placed between the foot and the sole of the plaster cast. Excellent results have been obtained by a number of surgeons in cases treated by this method; the ambulant treatment of fractures may be said to be still on trial, and its advantages can hardly be said to outweigh its disadvantages and dangers in the average run of cases. When used, the patient should, in my opinion, be kept under continuous observation.

**COMPOUND FRACTURES OF THE BONES OF THE LEG.**—These are frequent injuries, occurring either from direct or indirect violence. In the former case the fracture being usually compound from the start, in the latter case from within. In cases of fracture by violence there is frequently great injury of the soft parts, and laceration of the vessels.

**Treatment.**—Attempts should be made to preserve the limb in all cases in which the soft parts are not hopelessly injured, or in which the extent of such length do not have to be removed as would render amputation improbable. Even after removal of quite large fragments a good limb, although perhaps much shortened, may be obtained. In all cases except those in which the fracture is compound through the skin, or through a puncture, usually from within, primary fixation by silver wires or silver splints and screws will probably be the best method of treatment. Drainage should be employed in cases in which there is a probability of impairment of vitality of the soft parts, or in which primary infection of the wound may have occurred; and if the limb is swollen free incision of the deep fascia should be employed to relieve tension and secure free drainage.



applied immediately, being fenestrated later for dressing of the wound. Union without suppuration can very frequently be obtained, although the period required for solidification of the fracture will usually be much longer than in the case of simple fractures. The cast may be worn until union is firm, or some form of splint which provides for fixation of the bones may be applied, and by the use of the limb in locomotion union is sometimes hastened.

**Fracture of the Bones of the Foot.**—Simple fracture of the bones of the foot is not common. The bones of the tarsus are very seldom broken alone; practically the only ones which we need consider are the os calcis and the astragalus. Compound fractures of the foot are much more common, as a result of crushing injuries.

**FRACTURE OF THE ASTRAGALUS.**—The astragalus may be broken as a result of a fall from a considerable height, the patient alighting on the feet, although such violence is much more likely to result in fracture of one or both of the bones of the leg. There is not usually much displacement attending this fracture; and this fact, in connection with the swelling, may render the diagnosis difficult without an X-ray examination. There are pain, inability to walk, and considerable swelling, and it is sometimes possible by moving the foot to obtain crepitus.

**Treatment.**—Attempts should be made to reduce any displacement that is present, the leg being flexed upon the thigh during manipulation. The after-treatment consists in fixation of the foot at a right angle, preferably by a moulded binders' board splint, which is replaced in a week or ten days, when the swelling has subsided, by a plaster-of-Paris dressing, which is allowed to remain for five or six weeks. There is very likely to be considerable stiffness of the joint for some time after the fracture, and for this reason the foot must be kept at a right angle during the course of treatment.

*Compound fracture of the astragalus* may be an indication for operation when the injury to the other bones, bloodvessels, and soft parts is extensive. If amputation does not seem to be required, complete or partial excision of the astragalus as a primary measure will usually be indicated. Even under these circumstances a very good result as regards function will often be obtained.

**FRACTURE OF THE OS CALCIS.**—This may be produced by direct violence, as from a fall, as in the case of the astragalus, or from muscular action, the posterior portion being torn off by the contraction of the strong muscles of the calf as a result of sudden and violent muscular contraction (Fig. 137). When the body of the bone is broken the deformity is not usually very marked; there is swelling, and perhaps broadening of the sole, or decrease in the vertical diameter of the foot if the subastragaloid portion is crushed. When the

ty is torn off by muscular action it can be felt to be separated from the rest of the bone, being drawn upward by the muscles attached to it.

*atment.*—In the subastragaloid variety the foot is maintained at an angle to the leg, and the limb placed in a fracture-box, or a pasteboard splint or plaster-of-Paris dressing is applied to

FIG. 137.



Fracture of the os calcis. (Dennis.)

and leg. In fracture of the tuberosity the indications demand elevation of the foot to secure relaxation of the muscles acting upon it, not being fixed in this position by the application of a well-constructed splint to the anterior surface of the foot and leg, or a plaster-of-Paris dressing, which is allowed to remain for from six to eight

days. A compound fracture of the calcaneum will usually call for excision of the bone where the injury is not so severe as to necessitate amputation.

**FRACTURE OF THE METATARSAL BONES.**—These occur usually

from direct violence, as from a heavy body falling on the foot or a wheel passing over it, and are very often compound. The first and fifth metatarsal bones are most frequently fractured. In the case of simple fracture crepitus can usually be elicited, and angular deformity often detected on the dorsum of the foot.

*Treatment.*—The treatment consists in the application of a moulded binders' board splint to the foot and leg or the application of a plaster-of-Paris dressing. In the case of *compound fracture* the foot may be placed in a fracture-box after an antiseptic dressing has been applied. Union is quite firm at the expiration of a month.

**FRACTURE OF THE PHALANXES OF THE TOES.**—These are also usually results of crushing injuries, and are generally compound. A plantar splint, taking in the whole sole of the foot, or a moulded binders' board splint, surrounding the injured toe and extending for some distance backward on the sole of the foot, will be indicated. Union is usually sufficiently firm at the end of three weeks for the dressings to be dispensed with.

**Fractures of the Pelvis.**—Fractures of the pelvis are comparatively seldom met with. They occur as a result of direct violence, as where the pelvis is caught and crushed in bumper accidents, and also in consequence of falls from a height, striking either upon the feet or the pelvis; the latter is the most common cause. The fracture may involve almost any portion of the pelvis, or there may be two, or even more, independent lines of fracture. The symptoms differ somewhat, according to whether the pelvic girdle is broken, and the most dangerous fractures are those associated with injury of the pelvic viscera. Rupture of the bladder or of the membranous portion of the urethra, laceration of the rectum, and injury of the iliac arteries and veins are among the serious consequences of fracture of the pelvis. Careful examination should be made in all cases of fracture of the pelvis to ascertain the presence or absence of these complications. Rectal examination should never be omitted and vaginal examination sometimes detects laceration which otherwise would pass unnoticed; different portions of the pelvis may be palpated at the same time.

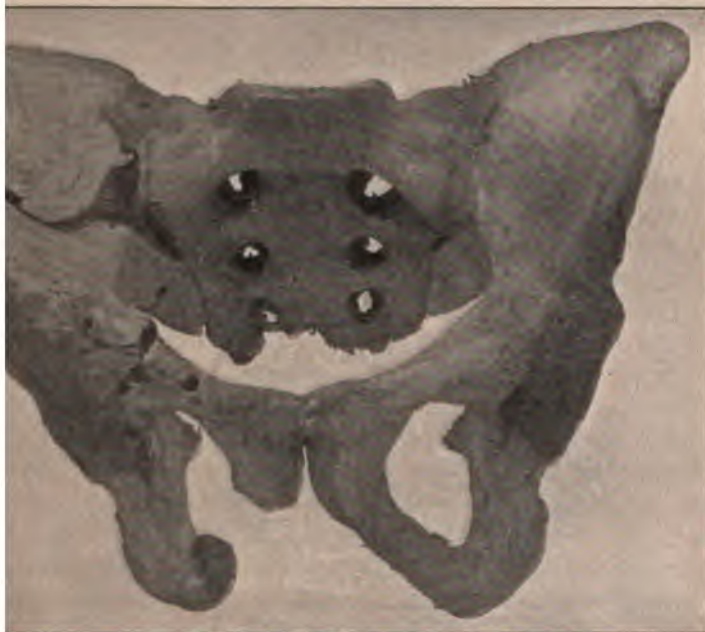
**FRACTURE OF THE ILIUM.**—The crest of the ilium may be partially separated, the anterior superior spinous process may be detached, and, if the fracture extends through the body of the bone, the pelvic girdle fractured (Fig. 138).

*Symptoms.*—The symptoms of partial fracture of the ilium are usually mild. Mobility and crepitus can be detected by manipulation; and when the anterior superior spine is detached, it is sometimes drawn downward by the action of the sartorius muscle. As a rule, the fragments of the crest of the ilium are not markedly dis-

When the pelvic girdle is broken the patient cannot stand. Lateral pressure may elicit crepitus, and the abdominal viscera injured.

*Treatment.*—In partial fractures union usually takes place rapidly. The patient is placed upon his back in bed, and the lower extremities supported by pillows, while the head and shoulders are supported in a similar manner, to secure relaxation of the abdominal muscles. The pelvis is then enveloped in a firm muslin binder, or broad strips of plaster are used to encircle it and secure fixation. The patient should be confined to bed for from four to six weeks. The

FIG. 138.



Fracture of the ilium. (Dennis.)

may be placed upon a Bradford frame if desired. In comminuted fractures of the ilium or other portions of the pelvis loose fragments should be excised, the bones may be wired, and, after the application of the dressing, the pelvis surrounded by broad strips of plaster.

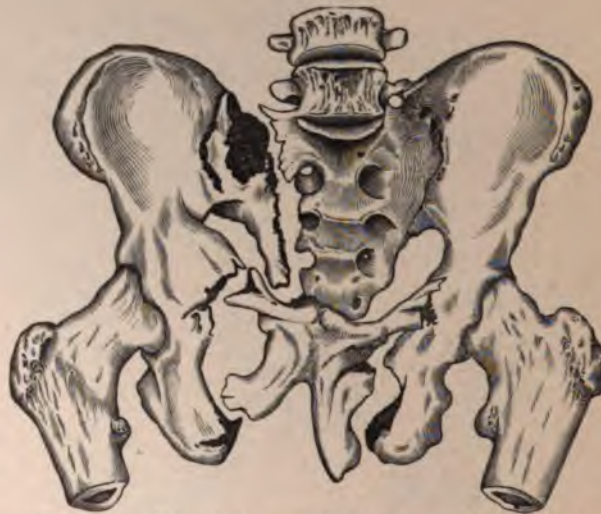
**FRacture OF THE PUBIS.**—The pubis is the portion of the pelvis most frequently fractured. It may be broken at any portion, transversely or the descending rami, or through the body, or be a diastasis of the pelvis at the pubic articulation. The ischium is usually broken, and the ilium may be also fractured in



its posterior portion, or there may be a separation of the sacro-iliac joint (Fig. 139). Rupture of the bladder or of the membranous portion of the urethra are frequent complications. The bladder may be torn in separation of the symphysis through traction upon the ligaments.

*Symptoms.*—These are pain, increased by movement, sometimes crepitus and mobility, inability to stand or walk, and, where a separation takes place at the symphysis, it may be detected by digital examination. If the urethra or bladder be ruptured, there will be an association of the symptoms of these injuries, viz., pain, collapse, bleeding from the urethra, etc. Rupture of the bladder may be either extraperitoneal or intraperitoneal. In all cases in which fracture of the pubis is suspected a catheter should be passed, to detect any laceration of the urethra or bladder which may be present.

FIG. 139.



Double vertical fracture of the pelvis: vertical of the sacrum, double of the pelvis. (Stimson.)

*Treatment.*—The treatment consists in confining the patient to bed in the dorsal position, the thighs being flexed, and surrounding the pelvis either by a muslin binder or by broad strips of adhesive plaster. This treatment should be continued for six weeks. Rupture of the bladder or urethra will require the treatment appropriate to these injuries.

**FRACTURE OF THE SACRUM.**—Fracture of the sacrum as an independent injury is rare. It occurs either as the result of a fall or a blow, usually giving way in the lower portion, the line of fracture being transverse.

*Symptoms.*—These consist in an anterior displacement of the lower fragment, which can be detected by rectal examination, when mobili-

use of opium if there be much pain, being occasionally opened  
ma. The patient should be confined to bed for at least four  
or as much longer as the symptoms may indicate.

**RACTURE OF THE COCCYX.**—This is also a rare injury, occurring  
sult of direct violence from behind forward. The lower frag-  
is usually pushed forward, as can be detected by rectal exami-

. Coccygodynia sometimes follows this injury.

**atment.**—Confinement to bed, and the use of a rubber or oakum  
pads, to prevent pressure upon the coccyx, should be instituted,  
e displacement reduced as far as possible. Union is usually  
firm at the end of three weeks, although permanent deformity  
bone may be expected.

**RACTURE OF THE ISCHIUM.**—This is a very rare form of fract-  
ut may be associated with fracture of the pelvis elsewhere.  
e of fracture may be through the ramus or near the acetabulum,  
tuberosity may be broken off. It occurs as a result of direct  
ce, such as a fall upon the buttocks, and the pelvic viscera are  
ntly injured.

**ptoms.**—The symptoms of this fracture are pain, inability to  
or walk, mobility, and crepitus. The seat of fracture may  
be detected by rectal or vaginal  
nation.

**e prognosis** of simple fracture of the  
n is rather favorable.

**atment.**—This consists in confine-  
to bed in the dorsal or lateral  
e, the limbs being flexed over pil-  
This treatment should be persisted  
six weeks, at which time union is  
advanced.

**RACTURE OF THE ACETABULUM.**—

FIG. 140.



is replaced in the acetabulum, and in the fact that the displacement recurs with the same facility. It must also be distinguished from fracture of the neck of the femur.

*Treatment.*—This consists in reduction of dislocation if it be present, and the application of extension on the injured side, with the addition of a compress above the fragment. Extension should also be practised when the acetabulum is more extensively injured, and should be maintained for from four to five weeks.

**Fractures of the Skull.**—It is difficult to consider the subject of fracture of the skull apart from injury to the brain, its bloodvessels and coverings, from the association with which fracture of the skull derives its chief importance. It will be necessary, therefore, to dwell somewhat upon the associated injuries of these parts.

Fracture of the skull results from both direct and indirect violence. A fall, striking upon the head, or a blow with a blunt or sharp-pointed object, or the impact of a rifle- or pistol-ball, may cause a fracture at the point struck, or radiating from it, or the skull may be broken at a point on the opposite side. A fall upon the buttocks may cause fracture of the base of the skull, or the force of a blow received upon the chin may be transmitted through the condyles of the jaw to the base of the skull. The mechanics of fracture of the skull have been the subject of much study. It is difficult in many cases to determine why violence received upon a certain portion of the skull should result in a lesion of the bone at a neighboring or remote area, yet such will often be the case. Of the theories which have been put forward to explain the location and direction of fractures of the skull other than the depressed variety seen at the point of application of violence, it will only be necessary to mention two or three. Felizet's theory was that in the skull there were certain pillars or buttresses of thick bone, running in a vertical direction from the base to the vertex, and that the lines of fracture travelled in the thin bone between these buttresses. While some cases seem to bear out this view, in others the lines of fracture run quite independently of the direction of these thickened areas. Another view, and one which better explains the clinical facts, is what is known as *the bursting theory*. When a skull is compressed in a vise, or when it is struck by a violent blow, its elasticity permits it to be compressed in the diameter corresponding to the direction in which the force is applied, the corresponding transverse diameter being correspondingly lengthened and its transverse circumference increased. This increase in the transverse circumference, if carried beyond the limits of adhesion, results in separation of the bone, and this separation, or fissuring, takes place along the line of the meridians running from one end of the vertical diameter to the other, which are naturally separated from each other



the skull is compressed at its two poles. Thus, a blow struck on the front or back of the skull produces a longitudinal fissure on the vertex, or the base. If the blow is received upon the side of the head, the line of fissure will be transverse. Occasionally, instead of the fissure following this direction, it will take place in a line transverse to the meridian, and at the point of greatest depression, at the edge of the depressed area, resulting in what is known as a *ring fracture*. By *contre-coup* I mean a fracture of the skull at a point opposite to that on which the skull is struck, the bone being unbroken, as when a blow upon the occiput produces a fracture in the anterior fossa. The most reasonable explanation is that the violence is transmitted to the opposite side of the skull by a wave transmitted to the brain from the point at which the skull is struck and compressed. The vibration of the semi-fluid brain has been given as the cause of the extensive shattering of the skull observed in cases of gunshot wound of the head by the modern calibre rifle, the ball exciting a backward and forward wave in passing through the brain, which breaks the skull to fragments.

The character of the fracture differs according to the nature of the weapon producing it, and the force and momentum with which it is struck. A large or blunt instrument is more likely to be associated with extensive fissuring of the bone. If the blunt object is of small size, the area of the fracture is small, the outer table is depressed, the diploë is crushed, and the inner table, by the continuance of the force, is fissured, or depressed to a still greater degree. A pointed weapon produces a clean wound of the outer table, and the force and momentum continued the inner table is also fractured. In penetrating fractures, owing to diffusion of the force, the inner table is usually more extensively injured than the outer, the fragments sometimes being carried into the brain. In the case of a bullet wound, if the force and impetus be sufficient to carry it through the skull, the outer table at the point of exit is more extensively splintered than is the inner table. In thin bones the opening may be small and rounded, with splintering of the edges. A clean-cut fissure without depression

FIG. 141.

Fracture of the internal table of the skull.  
(Bergmann.)

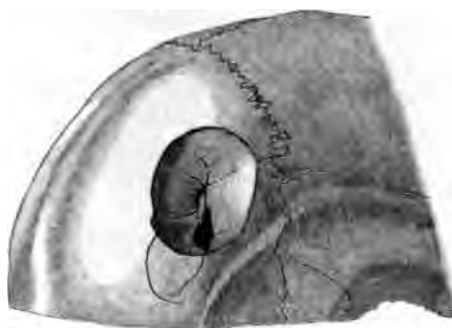
and impetus be sufficient to carry it through the skull, the outer table at the point of exit is more extensively splintered than is the inner table. In thin bones the opening may be small and rounded, with splintering of the edges. A clean-cut fissure without depression



sion may be produced as the result of a quick, sharp blow with a light object. In those fractures the result of the application of diffused violence over a large area, in which compression of the skull, already mentioned in speaking of the mechanism of fracture, takes place, widespread fissuring is usually present, and associated with extensive contusion or laceration of the brain. Fissures of the skull usually pursue their course independently of any relation to the sutures; but occasionally, and more especially in children, diastasis takes place. The inner table is very rarely fractured without injury of the outer table of the skull, as the result of a bullet wound, which glances from the bone, or a blow with a small round object (Fig. 141).

Fractures of the skull may be simple or compound. The presence of a wound communicating with the fracture increases the

FIG. 142.



Circumscribed depressed fracture of the skull. (König.)

danger of the injury, as it increases the liability to infection of the brain and membranes, either primarily or secondarily, to osteomyelitis and necrosis. Meningitis and encephalitis are frequent results of infection in compound fractures.

**FRACTURES OF THE VAULT OF THE SKULL.**—These may be either fissured, depressed, or punctured in nature, and may also be associated with fracture of the base.

*Symptoms.*—Depressed fracture is often unassociated with any symptoms of injury to the brain. In other cases the symptoms of concussion, contusion, and laceration of the brain overshadow those of fracture, and when the latter is of the nature of a fissured fracture it may escape recognition unless the wound be compound. The symptoms pertaining to the fracture itself are usually slight, unless a large area of the skull is affected, or unless there is considerable depression. Mobility is usually more prominent than deformity, but crepitus is seldom to be detected. Local pain and tenderness are symptoms of considerable importance. A

ma of the scalp often renders the diagnosis more difficult. A hematoma very frequently gives the impression of a depressed fracture to the examining finger. The blood on the outer edge of the swelling comes firm, while that in the centre remains fluid, and thus creates a depression. It can be distinguished from a depressed fracture by noting the fact that the hard circumscribed edge is elevated above the level of the surrounding bone, while firm pressure in the centre will usually detect a hard base at the level of the surrounding bone. It is impossible, however, in a few cases to distinguish positively between them. Nodes and congenital deformities may lead to errors in diagnosis; the fact that they are frequently bilateral will be of service in distinguishing them. When the fracture is compound there is usually very little difficulty in detecting its presence.

Symptoms of injury to the brain itself may exist independent of fracture, and are due to contusion or laceration of the brain tissue, to hemorrhages, large or small, scattered through it, to rupture of the sinuses or of the meningeal arteries, and to injury of cranial nerves. They may also in the case of depressed fracture be due to local pressure and laceration by the fragments. The unconsciousness due to concussion or contusion of the brain comes on immediately after the injury, and where laceration is present is likely to last for a considerable time. Unconsciousness due to compression is usually the result of hemorrhage outside the dura, usually as the result of rupture of the middle meningeal artery or the lateral sinus, as well as unconsciousness from gradual compression from intradural hemorrhage. In the majority of cases it is separated from the time of injury by a short interval of consciousness. Where compression is the result of a depressed bone there may be symptoms of motor irritation in the muscles adjoining the fracture. Localizing symptoms are also present, as in the case of gradual compression due to localized hemorrhage. These pass into the symptoms of general compression of the brain. A slight elevation of temperature is the rule in injury of the brain. When accompanying hemorrhage it is moderate, being higher in the case of laceration of the brain.

**FRACTURE OF THE BASE.**—As already mentioned, fractures of the base of the skull occur as the result of transmission of force from various parts of the skull, either by contre-coup or direct ex-

itself. The line of fracture may involve any of the three fossæ and may extend from one to the other (Fig. 143).

*Symptoms.*—The special symptoms of fracture of the base are the escape of blood and cerebrospinal fluid from the ear, subconjunctival ecchymosis appearing some time after the injury, bleeding from the nose, and paralysis due to involvement of the cranial nerves. The escape of blood and cerebrospinal fluid from the ear is a very valuable symptom of fracture of the middle fossa. In these cases the fracture extends through the petrous portion of the temporal bone, communicates with the middle ear, and by rupture of the tympanum with

FIG. 143.



Fracture of the base of the skull. (Bruns.)

the external meatus, and, on the other hand, by rupture of the eardrum and communication with the subdural space. Hemorrhage does not continue usually more than twenty-four or thirty-six hours. The cerebrospinal fluid is recognized by the fact that it is clear, and contains very little albumin and a large amount of salt. It is usually slight in quantity, but sometimes profuse, appears after hemorrhage has ceased, and usually continues for two or three days, although in some cases it persists a longer time. The blood and cerebrospinal fluid may also find their way to the nose or mouth in fractures of the base, although the cerebrospinal fluid would be more difficult of recognition in such cases, as hemorrhage from the nose could easily occur without serious in-



*pair of fractures of the skull* takes place by the formation of a amount of callus, mainly formed by the diploë, and to a less by the periosteum. The power of the skull to reproduce bone the place of fragments removed is very limited, and where has been extensive removal of bone a considerable gap usually as. Depression not treated by operation is usually permanent, in the case of infants, in whom it often spontaneously disappears.

*treatment.*—Fractures of the skull derive their main importance, been said, from the liability to injury of the underlying brain. symptoms of the brain injury are often independent of and over- w those of fracture, and render the latter of secondary con- tion. In other cases surgical intervention is of first importance. treatment differs as the fracture is simple or compound, fissured or sed. In the case of simple fracture we should remember that there finite risk in converting it into a compound fracture by operation, gh under modern technique this has been enormously reduced. e same time it cannot be entirely disregarded. In the case of a e fissured fracture without symptoms, or in which the symptoms o be dependent upon widespread contusion and laceration, proba- dependent of the injury to the bone, a non-operative course of ent is to be recommended. This consists in absolute rest and on a milk diet, the application of cold to the head, and the admin- on internally of small doses of calomel, which may be combined advantage with a little Dover's powder. Even where symptoms sent, in the case of every patient who has suffered concussion, r without fracture, such a course of treatment should be persisted several weeks. Where there are localizing symptoms suggest- calized pressure from depressed bone or from a clot, and a re is present or suspected, the question of trephining is to be lered, as we must remember that the injury to the internal table



fracture in which no symptoms of compression of the brain are present. The brain usually accustoms itself to a moderate decrease in the intracranial space; at the same time, however, the possibility of long-continued irritation with the subsequent appearance of epilepsy leads many authorities at the present time to urge operation in all cases of depression, even when unassociated with symptoms. In the case of children this depression often spontaneously disappears. Where the depression is the result of a blow with a small, pointed object, indications for trephining are stronger than where the depression is shallower and more extensive, as the internal table in the former case is liable to be more or less extensively splintered.

In the case of *compound fractures* the first indication is to clean carefully the wound and surrounding area. This is best accomplished by shaving the entire head, disinfecting the skin surrounding the wound, carefully sterilizing the wound, removing all foreign bodies and hair, and then proceeding to a careful examination of the fracture itself. In this case all depressed fragments must be elevated, even if no symptoms be present, loose fragments removed, and, if the dura is found to be lacerated, it should be sutured. The fragments can usually be elevated without the use of a trephine, by means of an elevator or a chisel. The wound is then drained either with a small rubber drainage-tube or with iodoform gauze, and either sutured or allowed to remain open, as may be indicated by the condition of the tissues and the probability of infection, and the same medicinal measures instituted as were described above.

In the case of gunshot fractures of the skull the wound or wounds should be enlarged (after careful sterilization), all depressed fragments elevated, loose fragments removed, and the bullet extracted if this is possible without extensive search. In a number of cases recovery has taken place with the ball still in the skull, but statistics show that the mortality from injury of the brain by foreign bodies is less by nearly half when the body is removed. At the same time extensive search is liable to result in dangerous injury to the brain. If probing is resorted to, it must be with all gentleness. If the ball seems to have passed through the brain and lodged on the opposite side, the skull may be trephined at this point, although even then may not be found. Free drainage is indicated.

Where the symptoms point to compression from extradural hemorrhage, this will usually be the result of laceration of the middle meningeal artery, the anterior branch of which is the most usual source of the hemorrhage, or from rupture of the lateral sinus. In such cases no time should be lost in trephining at the point at which experience has shown the clot can be most readily reached. The anterior branch of the middle meningeal artery can be located a

reached by applying the trephine on a line drawn two fingers' breadth above, and parallel with the zygoma, at the point where this line is intersected by another vertical line drawn a little more than one finger's breadth posterior to the junction of the malar bone with the zygoma. A clot arising from the posterior branch may be removed by an opening three inches behind this point.

**Fracture and Dislocation of the Vertebæ.**—These are comparatively rare injuries, forming but a small proportion of all fractures and dislocations. As they are frequently combined in the same

FIG. 144.



Transverse fracture of a vertebra. (Stimson.)

FIG. 145.



Fracture of the fourth and fifth dorsal vertebra with marked compression of the spinal cord, caused by a fall from a great height. (Roberts.)

case, and as it is often difficult to exclude one or differentiate between them, it will be of advantage to discuss them at the same time. Like fracture of the skull, in which the association of injuries to the brain is the paramount feature, in fractures and dislocations of the vertebrae it is the participation of the spinal cord and nerves that gives such dislocations their principal importance and has the greatest influence upon the prognosis and treatment.

These injuries are rare in children. They occur in consequence of direct and indirect violence. Fractures from direct violence, as a blow upon the back, are usually of a spinous process or of one or both laminae. Indirect violence, such as a fall upon the head or the buttocks, or violence applied to the head, as in riding under an arch, or overflexion of the spine from any cause, usually results in a combination of fracture of the bodies of one or more vertebrae (Fig. 144), and perhaps of their articular cartilages, and displacement of one vertebra upon the one below it, the upper being usually displaced forward (Fig. 145). The body of one vertebra may be crushed

between those above and below, or by overextension of the spine two of the segments may be torn apart.

The vertebræ most frequently broken are the fifth and sixth cervical, the twelfth dorsal, and the first lumbar. Pure dislocation

FIG. 146.



Complete unilateral dislocation by rotation or abduction; cervical vertebra. (König.)

without fracture is rare, and nearly all the instances have been in the cervical region, especially the lower half. The dislocation may be

FIG. 147.



Bilateral dislocation forward of the fifth cervical vertebra. (Stimson.)

unilateral (Fig. 146), consisting in forward displacement of the articular process in front of the one below; or bilateral (Fig. 14



the symptoms of the fracture, or fracture-dislocation, as it is when, as is usually the case, these injuries are combined, are rigidity, pain and tenderness, altered mobility, and sometimes deformity.

The deformity may consist in a prominence of the spinous process of the vertebra below the fracture, due to displacement forward of the injured vertebra, of angulation, or lateral deviation of the spinous processes, due to crushing of the body of a vertebra, in the former or to its rotatory displacement in the latter, and depression of the spinous process when its base and laminae are fractured.

In fracture-dislocation in the cervical region the head is turned to the same side when the displacement is unilateral, and usually bent backward when it is bilateral. Deformity in the bodies of the four upper cervical vertebrae can be palpated through the mouth. Pain is usually referred to the seat of injury, and tenderness will aid in finding the same. Mobility is usually decreased instead of increased, the muscles being rigid. This rigidity is more marked in fracture-dislocation than in fracture. Mobility between fragments can sometimes be detected. Crepitus cannot usually be elicited, but may be produced by the patient himself. The symptoms of injury to the cord vary with the extent to which it is injured and the seat of the fracture. The injury may consist of complete crushing of the cord between the upper and lower vertebrae, of partial crushing, of laceration by the fragments, or of hemorrhage outside of the cord or into the cord itself, most frequently into the gray matter. The spinal nerves may be injured in their passage downward through the vertebral canal before they leave it, or at their points of exit through the intervertebral foramina. Descending myelitis with degeneration frequently follows as an injury to the cord. When the cord is completely crushed there is complete anesthesia and paralysis of the body below the level of the injury.



the distribution of the nerves arising there, and sometimes spasm and contractions in the muscles supplied by them. Gradually increasing paralysis may be due to hemorrhage. The bladder and intestines are paralyzed, retention being followed later by incontinence of urine and feces. Cystitis develops sooner or later. Pressure-sores form over the bony points of the lower portion of the back and the lower extremities. When the cord is injured above the fourth cervical vertebra death takes place instantly from paralysis of respiration, due to interference with the phrenic nerve. In injuries below this point and above the origin of the intercostal nerves respiration is diaphragmatic. Priapism is a frequent symptom in fractures of the cervical vertebrae. The reflexes are usually lost, but may be only temporarily abolished, and be later increased. Fever is usually present shortly after the injury, the temperature becoming subnormal later.

**PROGNOSIS.**—The prognosis in complete crushing of the cord is bad. The higher the injury is in the cord the sooner a fatal result may be expected. In fractures of the cervical region death usually takes place in the first week; in the dorsal region the majority of cases die within a month. The prognosis is best in fractures in the lumbar region, in which case the patient may live for a year, and even recover entirely. Death occurs as a result of respiratory paralysis, of hypostatic pneumonia, from inflammation of the genito-urinary tract, and from exhaustion.

**TREATMENT.**—Great care must be exercised in handling the patient, as sudden movement or injudicious handling may cause great injury to the cord, or even sudden death. The question of operation will demand the first consideration. *Laminectomy* may be successfully employed to relieve pressure from a fractured spinous process or lamina, to aid in the reduction of a displacement, and for the evacuation of a clot. In cases in which it is clear that the cord has been completely crushed laminectomy is contraindicated. In cases of partial paralysis, suggesting pressure, in those due to direct violence, with fracture of the laminae, in which the chances of the cord escaping complete division are much better than in fracture-dislocations, or in which the symptoms from their gradual onset suggest hemorrhage into the canal or membranes, and, finally, in doubtful cases, laminectomy is indicated, and no delay should be made in carrying it out. Where laminectomy is not feasible or is contraindicated careful attempts should be made to reduce any deformity which is present. This is easiest of accomplishment in the cervical region, where extension combined with rotation may be successful in reducing a pure dislocation or one combined with fracture. The procedure is, however, somewhat dangerous, and may result in sudden

power down, extension and counter-extension, with direct traction on the vertebrae at the point of projection, may be instituted at once. A plaster-of-Paris jacket may then be applied. In the case of a fracture of the spine it is justifiable to suspend the patient in applying a plaster jacket as an aid to reduction. An expectant course of treatment is all that can be carried out. In any case of fracture of the spine whether operation is practised or a non-operative course is followed the after-treatment should be most carefully conducted. A plaster jacket is of advantage as affording equable support, and every precaution must be observed to avoid the formation of bedsores by pressure and the use of lotions, such as alcohol or a solution of iodine to harden the skin. In fractures of the cervical spine the neck should be fixed by sand-bags on either side. The bladder must be periodically emptied by careful aseptic catheterization, and cystitis when it develops treated by vesical irrigation with antiseptics. The bowels must be carefully regulated, the diet should be simple and of a nature to leave little residue, and laxatives should be used as indicated. If the patient recovers, the return of motion and sensation will be gradual, and the nutrition of the patient may be improved by electricity and massage.

**Compound fractures**, or open fractures, as they are called in contrast to the simple, or closed, fractures, are ones in which the fracture communicates with the external air by means of a wound. The presence of this wound influences to a considerable extent the progress of repair and the prognosis. Before the introduction of antiseptic methods compound fractures constituted a much more serious and even fatal class of injuries than at the present day. In the past the wound and osteomyelitis and necrosis were the rule and not the exception. To-day the surgeon looks with more confidence on a fracture compound in nature than formerly, but the after-treatment required must be correspondingly modified.

Compound fractures differ in degree and severity according as to whether the fracture be compound from within or compound from without. In the former case, in which the ends of the bones are exposed through the skin by the fracturing violence, by movements of the limb after the fracture has occurred, or movement of the limb during transportation after fracture, the opening is usually small, the wound is not very much lacerated or bruised, the wound less liable to

often at the same time comminuted, the bloodvessels and nerves are much more likely to be injured, and the necessity for amputation in the case of extensive crushes must be considered. Where amputation was formerly common it is now practised with much less frequency; but in cases in which so much bone requires removal as to render the limb useless, or where the skin and soft parts are much disorganized, and the principal bloodvessels lacerated, amputation will be required. The danger of infection has been to a great extent overcome.

**TREATMENT.**—Prevention of infection is the first measure to be taken in the treatment of a compound fracture. As an emergency measure it should receive prompt attention, the wound being irrigated if possible with an antiseptic solution, or, if this is not obtainable, with boiled water, and covered with dressings or cloths wrung out of the same.

The administration of an anæsthetic facilitates the dressing of these injuries, and should be practised wherever feasible in all except the very smallest bones. The surrounding skin should first be thoroughly disinfected in the usual manner, and the wound irrigated, preferably with a 1:2000 bichloride solution, as some infection will probably have already taken place. All foreign bodies should be carefully removed, and as in the case of railroad injuries considerable dirt, grease, etc., may be ground into the tissues, they may be lightly everted to remove the same, or pledgets of gauze used to swab out the wound. Fragments of muscle in which dirt is ground may be snipped off. After having thoroughly cleansed the wound, and the question of amputation having been decided by consideration of the principles laid down above, attention must be directed to the disposition of the fragments. Fragments entirely detached should be removed; those partially attached, the chances for the preservation of the vitality of which seem good, may be moulded into place. Primary fixation should then be practised, the fragments being drilled and sutured with heavy silver wire, or, if the surgeon prefers it, with kangaroo-tendon sutures; or the fragments may be fastened together with silver splints and screws, or with bone ferrules or Parkes clamps. In compound fractures in which there is much laceration of the soft tissues free drainage is usually indicated, and where there is much tension it may be necessary to divide the deep fascia more extensively to relieve it and provide exit for discharge from the wound. In the majority of cases in which the tissues are much contused very few sutures should be introduced, as any swelling which occurs is liable to cause extensive sloughing of the edges of a wound which has been tightly closed. Drainage-tubes should be inserted into dependent pockets, and counter-openings may be required. A large gauze dressing should be applied, and the limb dressed either

the bone are allowed to remain, in the majority of cases giving rise to no irritation. Where the wound is infected, however, fragments of necrosed bone may be cast off, and the silver wires or splints may not infrequently require removal before the sinuses close. No operation should be undertaken for the removal of the necrosed bone, unless union is progressing satisfactorily, until the fragments are loosened. In doubtful cases in which the question of amputation cannot be decided at the first dressing, a conservative course of treatment may be instituted without militating against a favorable result from amputation later, if it should be found necessary.

In cases in which the fracture is compound from within, or in which the external wound consists merely of a puncture, attempts to cleanse the wound after disinfection, and thus to convert it into a closed fracture, will often be successful, and in these cases primary fixation, by drilling and suturing of the fragments, may not be required. In compound fractures involving large joints, which were formerly subjected to amputation as a routine procedure, a formal or partial amputation of the joint will be indicated where there is comminution, or where the principal vessels and nerves are simultaneously lacerated. After-treatment consists in drainage, in fixation until repair of the joint is complete, and later the use of passive motion and massage.

**Gunshot Fractures.**—In this class of fractures we have, besides comminution of the bone, more or less damage of the soft parts, including bloodvessels and nerves, with perhaps the retention of a bullet in the body as complications. The nature of the injury differs with the range of the missile which produces it. A load of small shot at short range may cause a large wound and very considerable damage to the soft tissues. Fragments of shell may tear away a portion of the bone, shattering the bones very extensively, or even completely comminuting it. The modern small calibre, high velocity rifle appears to



in place (Figs. 148, 149). At long range the soft bones are likely to be perforated without splintering. The wound of entrance is small and clean cut, but at short range the fragments of bones are likely to damage the tissues considerably on the other side of the bone. Where the bone is not comminuted the wounds of entrance and exit are small, rather clean cut, and heal rapidly. The old, large calibre, low

FIG. 148.



Gunshot injury of the right femur at the junction of the middle and upper thirds by the .730-calibre German silver jacketed projectile, with the velocity common at 2000 yards. (Dennis.)

velocity rifle-ball usually causes more extensive damage to the soft parts, although the bone is likely to be less extensively injured. Amputation is much less frequent now than formerly in gunshot fractures.

TREATMENT.—All that has previously been said in regard to the prompt institution of antiseptic treatment holds true in the treatment of gunshot fractures. If the ball has not escaped, which will usually

FIG. 149.



Posterior view of gunshot injury shown in Fig. 148. (Dennis.)

be indicated by the presence of but one wound, it may be removed if readily accessible; although extensive exploration and dissection for its removal are contraindicated, as in the majority of cases its presence does not add sufficiently to the gravity of the injury to warrant these measures. After disinfection, provision for drainage by the introduction of a drainage-tube or strip of gauze should be made, and

the dressing applied and the limb immobilized as described above. Where there is extensive injury of the bone the same measures recommended in ordinary compound fracture in regard to the removal of fragments and primary fixation are applicable here. Amputation is required less frequently for injuries due to the modern rifle, and primary or secondary resection in case of the long bones may often be substituted for amputation. Secondary amputation may be required, as in ordinary compound fractures, for osteomyelitis, extensive necrosis, or gangrene.

**Delayed Union.**—Where union is not present at the expiration of the time usually required for repair of a bone it is said to be delayed. The causes of delayed union may be either constitutional or local. A depressed condition of the general health from any cause may lead to delay in repair; or the cause may be local in origin, and result from imperfect apposition or insufficient fixation of the fragments, and from necrosis of the fragments in cases of compound fracture, especially when suppuration has occurred.

**TREATMENT.**—This, in delayed union, consists in attention to the general health, with the administration of tonics, and in the use of efficient local measures, if such have not been previously employed. Immobilization by plaster-of-Paris dressings, changed at intervals of two or three weeks, and in some cases irritation of the ends of the bones by rubbing them together before applying the dressing, are efficient measures. Percussion of the seat of fracture, counterirritation and blistering, and Bier's elastic constriction have been recommended. Fixation should be maintained for some months, the neighboring joints also being immobilized, before the hope of obtaining union is abandoned; that is, if the seat of fracture be where bony union may reasonably be expected. If at the end of six months no union be present, the case may be fairly considered as belonging to the class of ununited fractures, and will require appropriate treatment.

**Ununited Fracture—Pseudarthrosis.**—Except in certain fractures in which we seldom expect bony union, as intracapsular fracture of the hip, transverse fracture of the patella, and intracapsular fracture of the humerus, non-union is rare. The proportion of cases in which it occurs is estimated at one to five hundred. The causes which contribute to non-union are the same constitutional and local influences mentioned as instrumental in causing delayed union, viz., a depressed state of the general health from any cause, such as disease, shock, gestation, or lactation, and local conditions, which include imperfect apposition and deficient immobilization of the fragments, too early removal of the dressings, suppuration and necrosis, and, in addition, the interposition of fragments of muscle, nerve, or fascia between the

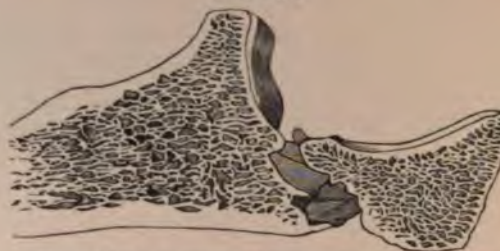


ends of the fragments, or tight bandaging, interfering with the blood-supply. Local disease of the bone, as syphilis and cancer, may be another cause.

Non-union is more usually a result of local than of constitutional causes, and in my experience the most frequent of these is the presence between the ends of the fragments of muscular tissue or fascia. Imperfect immobilization probably more often causes excess of callus from irritation than a lack of callus.

The pathological conditions found in cases of non-union vary in different instances. In some cases, comparatively rare, there is no

FIG. 150.



Fracture of the olecranon; fibrous union. (Malgaigne.)

attempt at union, the ends of the bone being rounded off and free. This condition usually results from great loss of substance of the bone, and with it there is great mobility. In others the process of union had gone as far as the formation of a band of fibrous tissue (Fig. 150), which may be quite short, or, when longer, permit of exten-

FIG. 151.



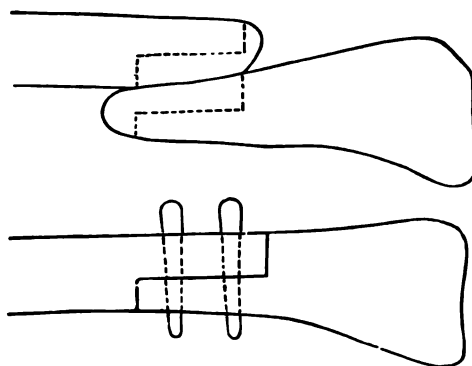
Ununited fracture of the femur with great overlapping of the fragments. (Dennis.)

sive separation of the fragments and considerable mobility. This is the usual condition presented. In a few cases there is an actual false joint formed between the fragments (Fig. 151). The fibrous tissue, instead of becoming calcified, forms a sort of capsule around the ends of the bones, which by long-continued friction become adapted to each other, forming a ball-and-socket joint, which contains synovia-like fluid, and the walls of which are smooth and resemble

endothelium. This condition of pseudarthrosis probably occurs from long-continued friction in cases of transverse fracture united by fibrous tissue with close apposition of the fragments.

**TREATMENT.**—The treatment of non-union and fibrous union depends on the location of the fracture, the length of time which has elapsed, the age of the patient, his constitutional condition, etc. In some bones in which fibrous union is close the disability is not very marked, such being the case in the upper extremity, while in the leg and thigh the resulting disability will be very much greater. The treatment involves the same attention to constitutional measures which was mentioned in speaking of delayed union. It may be granted that prolonged immobilization and removal of any apparent displacement have been previously practised. The question of operation will now present itself. Friction and percussion may first be

FIG. 152.



Volkmann's operation for pseudarthrosis.

given a trial. The application of a brace to the lower extremity, encouraging the patient to walk upon it, will often be very beneficial, especially after compound fractures attended with loss of a considerable portion of bone, in which we do not look for speedy union, and in which operation may be deferred much longer than in cases of different origin. The stimulation of the ends of the bone and the increased blood-supply following the use of the limb, in combination with a brace which affords good fixation, may in the case of the tibia and femur give good results.

The *operative measures* consist in drilling the ends of the bones subcutaneously, or freshening them with a small osteotome in the same manner; or the bones may be exposed by open incision, the ends freshened, all intervening tissue removed, and the ends brought together and fastened by suture or other measures. In some cases of oblique fracture a mortice can be sawn (Fig. 152). The methods



used to fix the ends consist of the insertion of chromicized catgut, silk, or silver wire sutures (Fig. 153) passed through holes drilled in the ends of the bone, silver screws penetrating each fragment, or silver plates overlapping each fragment and fastened with silver screws (Fig. 154), ivory nails and pegs, bone ferrules, and the use of Park-hill's clamps and screws. The silver sutures and plates can be closed in and the wound sutured, and usually cause no irritation unless sup-puration occurs. Where one of two parallel bones is ununited it is necessary to remove a corresponding section of the opposite bone

FIG. 153.



Fragments in ununited fracture  
secured by silver wire.

FIG. 154.



Fragments in ununited fracture  
secured by silver splint.

before the ends can be approximated (Fig. 155). Infection of wound diminishes very much the prospect of success of any operation. A plaster-of-Paris bandage should be applied after operation in the case of the lower extremity, and either a plaster-of-Paris bandage or splints used for immobilization of the upper extremity. Great caution should be exercised in changing the dressings, and the part should be guarded from injury for a long time.

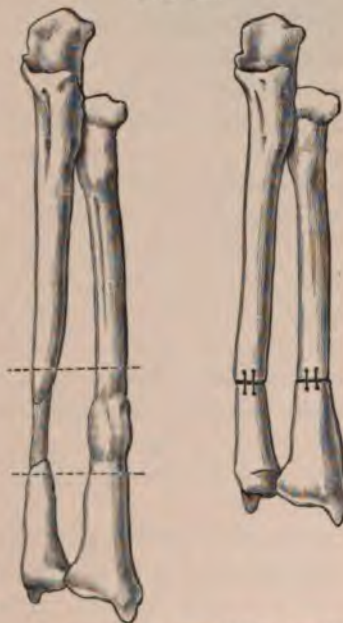
When there is a considerable gap in the bone after removal of fibrous tissue, or where a considerable portion of one of two parallel bones is wanting in the forearm or leg, attempts are sometimes made to graft a piece of fresh bone from a recently killed animal, or to fill in the space with decalcified bone chips, which form a framework for the deposition of granulation-tissue. If these measures fail, as they frequently will in the case of the arm and leg, the remaining bone may be shortened to a corresponding extent; or if this would involve sacrifice of too much of the length of the limb, a plastic operation

may be performed, transplanting a portion of the remaining bone, or even dividing it, and fastening one end to the opposite fragment of the injured bone.

**Deformed Union.**—It is rarely possible to obtain an absolutely perfect result after fracture. Slight shortening of the fractured bone is inevitable, although it may be imperceptible. In the case of a bone like the femur it is usually present to a measurable degree, at least in all except very young children. Conspicuous deformity (Fig. 156) may depend on the nature of the fracture and injury to the soft parts as much as on the methods of treatment. The patient may be to blame when the surgeon's orders are not obeyed, or the presence of some complication like acute mania or delirium tremens may interfere with the treatment and result in a marked deformity. Careless or fully erroneous interpretation of roentgenographs, in which a trifling and useless displacement can very often be detected in a functionally perfect result, may lead to much annoyance and professional injury to the medical attendant.

**TREATMENT.**—If the deformity be such as to interfere with the usefulness of the part, attempts to correct it can often be made with fair

FIG. 155.



Non-union in one of two parallel bones, showing the lines of section and suture. (Dennis.)

FIG. 156.



Union with deformity in fracture of the femur. (Dennis.)

prospects of success. In some cases this may be required for cosmetic reasons. Angular deformity is easier of correction than lateral

deformity. Overlapping, causing longitudinal displacement, is usually impossible of correction when much time has elapsed, without resection of the bone, as the muscles become correspondingly shortened.

In recent cases in which the callus is not very firm, forcible bending under an anæsthetic will often be successful; the callus may be refractured in the same manner. Where union is firm, open incision is the best method of correction, the bone being divided by an osteotome, or a V-shaped piece being removed from the apex of the angle—cuneiform osteotomy. Davis has practised osteotomy with success for gunstock deformity following condyloid fracture of the humerus, dividing the bone from the inner side, above the internal condyle and restoring the *carrying angle*.

**Consecutive shortening** is most commonly observed in fracture of the lower extremity from a too early use of the limb in locomotion. The soft callus is compressed and consolidated by the weight of the body. It is avoided by forbidding the use of the part until consolidation seems complete, and directing cautious use of it for some time after. Callus sometimes softens down or disappears as a result of constitutional conditions, such as rachitis, or an intercurrent affection like typhoid fever. Union usually takes place later as the patient improves in health, and immobilization should therefore be persisted in.

**Fracture of Callus.**—This usually occurs from violence to the part shortly after the fracture has united, or when the dressings have been removed before union at the seat of fracture is complete. A fall under such circumstances may result in refracture at the same place. The prognosis for speedy union is good, less time being consumed in repair than after the original fracture. When firm bony union has taken place the bone, if exposed to violence, is more likely to give away at some other point than at the site of the original fracture.

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## DISLOCATIONS.

A *dislocation*, or *luxation*, is a displacement of the articular surface of the bones which enter into the formation of a joint. The dislocation is named from the distal bone; thus a dislocation of the shoulder joint is understood to refer to a displacement of the humerus. *Diastasis* is the separation at the junction of one bone with another, and is principally seen in the bones of the pelvis, at the symphysis pubis and the sacro-iliac junction.

Dislocations may be classified as traumatic, congenital, pathologi-

causes, such as excessive effusion into the joints, weakening of the ligaments as the result of inflammatory changes of various kinds, and paralysis of the muscles holding the bones in position.

**Complete Dislocation.**—In this form of dislocation the articular surfaces of the bones which enter into the formation of the joint are separated from one another; when portions of the articular surfaces remain in contact with one another the dislocation is described as *incomplete*, or *partial*; it is also sometimes described as a *subluxation*.

**Simple, or Closed, Dislocation.**—This is one in which the displaced articular surfaces of the bones are not exposed to the air by a wound or laceration of the overlying soft parts.

**Compound, or Open, Dislocation.**—In this form of dislocation the articular surfaces of the bones are exposed to the air by a wound or laceration of the soft parts produced either by the force which caused the dislocation or by rupture of the surrounding tissues by the displaced bone.

**Complicated Dislocation.**—This term is applied to a dislocation in which there is, in addition to the displacement of the bones, a fracture of one or both of the displaced bones or laceration of an important artery, vein, or nerve.

**Stable Dislocation.**—This is a dislocation in which the bones remain in the same position in which they were first thrown by the traumatic force.

**Unstable, or Consecutive, Dislocation.**—In this form of dislocation the position of the displaced bone is changed by a continuance of the displacing force, by muscular contraction, or by manipulations attempted at reduction.



reduction of the dislocation have occurred; for instance, a luxation of the elbow-joint is an old dislocation at a much earlier period than one of the shoulder-joint.

**Causes.**—The causes of dislocation are exciting and predisposing.

The *exciting causes* of dislocation are violence, either directly or indirectly applied, and muscular contraction; the latter is probably a much less active factor in the production of dislocations than of fractures. Force may act *directly* upon the articulation, and the articular end of the bone is driven against a portion of the capsule, which gives way and allows the escape of the bone in a corresponding direction. Force acting *indirectly* upon an articulation is a much more common source of dislocation, as is seen in the case of dislocation of the head of the humerus or the head of the femur from falls upon the hand or the foot respectively. The majority of the typical dislocations are produced in this manner, definite portions of the capsule being especially liable to rupture in different joints. Dislocations resulting from indirect force are less likely to be accompanied by severe local injury of the surrounding soft parts than those following the application of direct force.

The principal *predisposing causes* of dislocation are:

**Form of the Articulation.**—Ball-and-socket joints, from the range of movement which they permit, are more liable to dislocation than ginglymoid or hinge-joints; the comparative frequency of dislocation of the shoulder-joint as compared with that of the elbow-joint is thus explained.

**Age.**—Dislocations are very uncommon in childhood, because of the absence of great muscular power, the presence of epiphyseal cartilages, and the flexibility of the soft parts about the joints. They are most common in adult life, and are relatively common in advanced age. Krönlein has pointed out that the relative frequency in old age is greater than the actual, if the number of dislocations in persons of over fifty years is compared with the number of persons attaining that age.

**Sex.**—Dislocations are much more common in males than in females, for the reason that males are much more exposed to the exciting causes of dislocation.

**Defective Articular Development.**—The imperfect development of the articular cavity or the articular ends of the bones may act as a predisposing cause of dislocation. Muscular paralysis producing relaxation of the ligaments of a joint, and articular disease resulting in distention of the capsule of the joint and elongation of the ligaments, are predisposing causes of dislocation.

**Muscular action** may also produce dislocation of a joint, and here the displacement results from exaggeration of the normal physiological

movement of the joint, as is seen in dislocation of the lower jaw and in the displacements that result in the convulsions of epilepsy.

*Injury of the capsule of the joint* is the most important factor in dislocations. The position and extent of the laceration of the capsule determine the direction taken by the displaced bone; where definite portions of the capsule have been torn typical dislocations result; where extensive laceration has taken place atypical displacements occur.

The position of the rent in the capsule usually corresponds to the weakest portion; the thickest portions of the capsule usually escape injury unless great force has been applied. In addition to the injury of the capsule there may be contusion and laceration of the soft parts surrounding the joint. Muscles may be contused or lacerated, or torn from their attachments; large arteries or veins may be contused or obstructed by pressure of the displaced bone, or even ruptured. Nerves also may be contused, stretched, lacerated, or ruptured in dislocations, giving rise to more or less immediate paralysis; or changes may occur in the nerves as the result of the injury, producing symptoms at a later period.

*Sprain-fracture*, or a fracture of the bony margin of the articular cavity, may also occur as the result of a dislocation; both of these accidents are serious complications which may lead to marked limitation of the movements of the joint.

After the reduction of a dislocation the rent in the capsule heals promptly, but permanent weakness of the capsule at the point of injury results, so that it is likely to rupture upon the application of slight force.

**Pathology.**—A dislocation is always followed by the escape of more or less blood and by the effusion of serum into the surrounding parts, but both of these fluids are quickly absorbed. In cases of dislocation following muscular relaxation, with elongation of the ligaments, displacement of the bone may occur without laceration of the capsule. If the dislocation is promptly reduced, the rent in the capsule heals, and the parts are soon restored to their normal condition. If, however, the dislocation is not reduced, the articular surfaces of the bone undergo changes. In a ball-and-socket joint the ligaments become wasted, the head of the bone

FIG. 157.



Scapula showing new socket formed in an old unreduced subcoracoid dislocation. (Cooper.)

atrophies, the cartilages disappear, the articular cavity becoming filled up and its margins absorbed and flattened, and the head of the bone, if it rests upon a bony surface, forms for itself a new socket. If the head of the bone rests upon muscle, tendon, or fascia, the soft tissue undergo condensation, a cup-shaped cavity of fibrous tissue is formed, which is attached to the margins of the displaced bone, forming a new capsular ligament, and a synovia-like fluid is often secreted (Fig. 157). In the case of unreduced ginglymoid or hinge-joints the bony prominences become rounded off in time, the bones accommodate themselves to their changed relations, and more or less motion may be regained, although the restoration of function is not usually so marked as in the case of ball-and-socket joints.

**Symptoms.**—The most marked symptoms of dislocation are :

1. *Change in the Shape of the Articulation.*—This is due to change in the position of the articulating surfaces of the bones, and tension or relaxation of the muscles in direct relation to the joint ; thus, flattening of the shoulder is a marked symptom in dislocation of the shoulder, and in many cases of dislocation prominence of the displaced bone may alter materially the shape of the joint.

2. *Change in the Length of the Part.*—This may consist either in shortening or in elongation.

3. *Loss of Function.*—This is usually present, the dislocated part being no longer capable of executing the ordinary movements, being generally rigid, muscular contraction assisting in the fixation.

4. *Change in the Direction of the Limb.*—This is usually very marked in dislocation, and is produced by tension of the ligaments and muscles, as well as by contact of the displaced bone with an abnormal bony surface. This change is well demonstrated in dislocation of the head of the humerus and of the femur.

*Crepitus.*—True crepitus cannot be elicited in cases of dislocation ; but a moist crepitus can often be obtained which resembles the friction of a cartilaginous surface over bone or that obtained in the case of inflamed bursæ or tendons.

*Swelling, pain, and discoloration* may also be present after dislocation, but these conditions do not differ materially from those observed after fracture.

**Diagnosis.**—Dislocation is most apt to be confounded with sprain or contusion of a joint or fracture. In *sprain* or *contusion* there may be swelling and pain with loss of function ; but marked deformity and rigidity are usually absent, and the administration of an anæsthetic will permit of the performance of the normal joint-movements.

The diagnosis is made from *fracture* by observing that in dislocation the normal joint-motions are limited, while in fracture preternatural mobility is present ; in dislocation the deformity if reduced

ion for stiffness or weakness of the joint to persist for some  
In many cases the occurrence of a dislocation predisposes to  
ent dislocation in the same joint upon exposure to violence,  
ie to weakness of the ligaments following the previous injury.  
duced dislocation causes a certain amount of permanent dis-  
although in some joints a fair amount of restoration of function  
ace after a time if the patient persists in using the part.

**tment.**—The indications in the treatment of dislocation are  
re the displaced parts to their normal position as soon as  
, and later to encourage the restoration of function in the

*action of Dislocations.*—The principal obstacles to the reduc-  
islocations are the anatomical relations of the joint and mus-  
sistance; the latter may be manifested by reflex tonic con-  
due to traumatic irritation, to voluntary contraction when  
ent resists the efforts of the surgeon, and to passive muscular  
om stretching of the muscles across the bony prominences.  
sition and size of the rent in the capsule may also be a for-  
obstacle to the reduction of a dislocation; this may be  
ly small, or there may be such extensive laceration that the  
action of the untorn portion of the capsule may not be avail-  
replacing the bone. The interposition of ligaments, nerves,  
sels, and fascia may sometimes act as a mechanical obstacle  
omplete reduction of dislocations.

*esthesia.*—This is a most powerful aid in the reduction of dis-  
; the active element of muscular spasm is entirely obliterated  
the general relaxation favors the manipulations necessary  
restoration of the displaced bone. An anæsthetic should, as  
be given before attempting the reduction of a dislocation,



ment. The great majority of dislocations can be reduced by manipulation. In cases in which the reduction cannot be accomplished by manipulation it may occasionally be necessary to resort to the application of force by extension and counter-extension, or to open incision.

*Extension and Counter-extension.*—This method of reduction is liable to do great violence to the soft parts in the neighborhood of the joint, causing laceration and rupture of muscles, veins, and bloodvessels, and even avulsion of limbs, and is now resorted to only in exceptional cases of long-standing dislocation. Extension or counter-extension may be employed by the hands of the surgeon or his assistants, or by the use of a compound pulley. The extending bands usually employed are made by folding sheets or towels into cravats and applying them by a noose-knot or clove-hitch at some distance from the displaced end of the bone.

If it is found impossible to reduce the dislocation or to maintain its reduction, resort should be had to the open operation, which can now be practised with comparative safety.

**Complicated Dislocations.**—A serious complication is the occurrence of a fracture in the same bone near or involving the dislocation. In such cases an anæsthetic should be administered, and, if the shaft of the bone has been fractured, the fragments at the seat of fracture should be fixed with splints or a plaster-of-Paris dressing, while manipulations are made to reduce the dislocation. When this has been accomplished an appropriate dressing should be applied for the fracture. Should the fracture occur so near the extremity of the bone that fixation of the fragments is impossible, attempts to reduce the displaced bone should be made by manipulation, and when this has been accomplished the dressing for the fracture should be applied; if it is found impossible to reduce the dislocation by these means, resort should be had to operative treatment. Wounds of bloodvessels and nerves complicating dislocations should be treated upon general principles.

**Pathological Dislocations.**—These may arise from a variety of causes, such as muscular relaxation or paralysis, excessive effusion into the joint-capsule, and weakening or absorption of the ligaments as the result of inflammatory changes. Intra-articular changes in the bones secondary to disease may also cause relaxation and shortening of the ligaments, and result in dislocation. It is important to recognize such displacements early, as their reduction can usually be accomplished without much difficulty, and their reproduction can often be prevented by appropriate treatment and the use of mechanical apparatus.

**Compound, or Open, Dislocations.**—In this variety of dislocation the end or ends of the displaced bones are exposed to the air through

a wound in the soft parts, and the existence of such a wound increases very materially the gravity of the injury. Compound dislocations may result from force applied from without lacerating the tissues and exposing the displaced bones in the wound, or more frequently from the displaced bone being driven through the soft parts and skin from within, and are much rarer than compound fractures. Hamilton, in a collection of one hundred and sixty-six dislocations, records eight only as compound.

**TREATMENT.**—Formerly compound dislocations of the larger joints were followed by so great a mortality under conservative methods of treatment that they were considered cases in which primary amputation was urgently indicated. Amputation is now rarely employed, except in cases complicated by extensive laceration of the soft parts and of important bloodvessels, as it is often possible to save the limb and preserve the function of the joint.

The treatment in any compound dislocation depends largely upon the amount of laceration of the soft parts, the condition of the large bloodvessels at or near the seat of injury, and the existence of a fracture at the ends of the displaced bones. In a compound dislocation in which the injury to the bloodvessels and soft parts or bones is not extensive, the protruding bone or bones, as well as the wound, should be carefully sterilized, the reduction accomplished, the wound drained and dressed with a copious antiseptic dressing, and the part put at rest upon a splint or fixed by a plaster-of-Paris dressing. In the smaller articulations, such as those of the fingers and toes, the results of this method of treatment are usually satisfactory. In the case of compound dislocations of the larger joints some diversity of opinion exists among surgeons as to whether it is wiser to reduce the dislocation and close the wound, or to excise, either partially or completely, the ends of the displaced bones. I think the judgment of most surgeons now is in favor of sterilization of the ends of the bones and the wound, of reducing the dislocation and introducing drainage, and, after applying an antiseptic dressing, fixing the parts by splints or a plaster-of-Paris dressing. Tenotomy of resisting tendons will often facilitate the reduction of compound dislocations, and subsequently favors immobilization of the parts. In compound dislocations in which there is a fracture of the ends of one or both bones, excision, either partial or complete, should be practised. After excision the wound should be drained, and the part dressed and fixed upon a splint, and at the end of ten days or two weeks, when the wound has healed, passive motion should be carefully employed, to prevent bony ankylosis, except in the case of the knee. I have seen most satisfactory results follow partial or complete excision of the shoulder-, elbow-, and ankle-joints in such cases.

## SPECIAL DISLOCATIONS.

**Dislocations of the Lower Jaw.**—Dislocation of the lower jaw is a comparatively rare accident, constituting about 4 per cent of all dislocations. It is more common in females than in males, and is an extremely rare injury in childhood. This dislocation may be *unilateral*, or *incomplete*.

A predisposing cause of this dislocation may be a shallow cavity, the articular eminences being unusually small. Relaxation of the ligaments or weakness of the muscles of mastication, as sometimes observed in feeble subjects, may also predispose to this. The causes which produce it are violence from falls upon the face, unusually wide opening of the mouth, biting upon hard substances, and dental operations.

Dislocation occurs at the moment when the lower jaw is depressed, the condyles moving forward and carrying with them the interarticular cartilages upon the articular eminences. When the condyles of the jaw are in this position, if the jaw is still depressed, the condyles are pulled from their articular surfaces by the action of the external pterygoid, masseter, and other muscles, and pass forward into the zygomatic fossa, the capsule of the joint rarely being torn.

**BILATERAL DISLOCATION.**—When both condyles of the lower jaw escape from their articulating cavities the front teeth are found separated for an inch or more; the mouth remains open (Fig. 158), and the line of the teeth in the lower jaw is in advance of that of the upper. The chin is unduly

FIG. 159.



Deformity resulting from bilateral dislocation of the lower jaw. (As

FIG. 158.



Bilateral dislocation of the lower jaw.

prominent (Fig. 159), the jaw is fixed, and pain is usually

depression is felt in front of the ear on the side of displacement and a prominence on the sound side. The incisor teeth of the lower jaw on the sound side are external to those of the upper jaw. *Duration*.—This affection is habitual in certain individuals, and symptoms are sudden immobility of the jaw, coming on while chewing or biting upon hard substances, slight separation of the incisor teeth, and inability to approximate the teeth. It is caused by the articular cartilages slipping behind the condyles and fixing upon the articular eminences.

FIG. 160.



Method of reducing dislocation of the lower jaw. (Hamilton.)

*Prognosis*.—Unilateral dislocation of the jaw may be confounded with fracture of the neck of the condyle. In fracture there is mobility, with a prominence of the fragment below the zygomatic arch, and the chin falls toward the injured side, while in dislocation of the condyle there is immobility and the chin inclines to the opposite side.

*Treatment*.—The patient is seated in a chair or placed upon a bed, and an assistant supports the head, while the surgeon standing in



that the jaw has changed its position he should remove his thumbs to prevent them being bitten. In cases of dislocation of some standing, enough force may not be obtained by the use of the thumbs, and wooden levers may be employed to depress the jaw at the same time that pressure is made beneath the chin. It is sometimes possible however to reduce dislocations of the jaw of several weeks' standing by simple manipulation. Anæsthesia will be of service in cases presenting great muscular rigidity and in old unreduced luxations. *Subluxation* of the jaw, if not reduced by the patient by muscular action, can usually be reduced by introducing a narrow wooden wedge between the teeth and prying the jaws apart, or the coronoid processes may be pressed downward and backward with the fingers. The *after-treatment* of dislocation of the lower jaw consists in applying a Barton bandage to fix the lower jaw in contact with the upper for a week or ten days. The patient should be careful in making movements of the jaw, or chewing hard substances for a few days, for fear of reproducing the displacement.

**NOISY MOVEMENTS OF THE TEMPOROMAXILLARY ARTICULATION.**—These consist in snapping sounds heard during the movements of the jaw in chewing, and are produced by the condyles of the jaw slipping forward upon their articular eminences when the jaw is depressed, and then suddenly slipping backward during its elevation. The condition is probably due to relaxation of the ligaments of the articulation, and seems to predispose to dislocation.

*Treatment.*—For its relief the injection of a few drops of absolute alcohol into the ligaments has been recommended, and has been practised in some cases with success.

**CONGENITAL DISLOCATIONS** of the lower jaw are extremely rare. A case has been reported by Mr. R. W. Smith, in which there was very imperfect development of the glenoid cavity, interarticular cartilages, ligaments, and muscles upon the affected side.

**COMPOUND DISLOCATIONS.**—These are uncommon, and are always due to direct wounds over the joint.

*Treatment.*—Reduction should be accomplished and the wound should be treated upon general aseptic principles. The possibility of ankylosis should be borne in mind, and motion should be encouraged as soon as practicable.

**Dislocations of the Sternum.**—Dislocation of the bones of the sternum from each other is a rare injury. It may consist in a separation of the body of the bone from the manubrium, or of the ensiform process from the body.

**DISLOCATION OF THE BODY OF THE STERNUM FROM THE MANUBRIUM.**—This dislocation may be produced by direct force or by forcible extension of the body. The displacement may be for-

or of the costal cartilages.

**symptoms.**—The usual symptoms of this dislocation are interference with the respiration and a projection upon the anterior surface of the sternum, due to either the lower end of the manubrium or the upper end of the body of the bone, according as the fragments are displaced backward or forward. The gravity of this accident depends largely upon its association with injury of the intrathoracic vessels.

**treatment.**—Attempts should be made to reduce the displacement in cases of dislocation of the manubrium or the body of the bone, but are not always followed by success. An anæsthetic should be administered if the patient's condition will permit of it, and flexion and extension of the trunk should be made, with direct pressure upon the projecting bone. If it is found impossible to reduce the dislocation, no violent attempts should be made, as patients have sometimes perished with marked deformity, and have subsequently suffered great inconvenience from it; but if the displacement causes great discomfort the displaced bone should be exposed by incision and removed.

**DISLOCATION OF THE ENSIFORM PROCESS.**—This is an injury which is occasionally produced by blows or kicks upon the epigastrium. The injury may be followed by severe pain in the region of the stomach, and difficulty in respiration and occasionally vomiting, which may persist for some time.

**treatment.**—Reduction may be accomplished by manipulation, which consists in pressing the fingers below the process and attempting to push it forward, or by making a puncture in the skin, introducing a tenaculum into the cartilage, and drawing it forward. If the deformity recurs and is accompanied by troublesome symptoms,

upper extremity of the sternum, and is caused by force shoulder, forcing it violently backward.

*Symptoms.*—These are the presence of a swelling in upper part of the sternum, a tense ridge corresponding to the origin of the sterno-cleido-mastoid muscle, a decrease in distance between the acromion process of the scapula and the shoulder, and a sinking downward and inward of the shoulder. Considerable disability of the arm and pain on movement.

FIG. 161.



Dislocation of the sternal end of the clavicle forward. (Dennis.)

The dislocation of the sternal end of the clavicle may be in the forward direction. It is then accompanied by a swelling in the upper part of the sternum. In a lesser degree of dislocation may also be associated with a fracture of the clavicle or of the edge of the sternum.

*Treatment.*—Reduction is effected by drawing the shoulder backward and at the same time moving the hand upon the end of the clavicle.

Reduction is often easy by this manipulation to reduce the deformity. It is difficult to maintain the reduction. The dressing consists of a bandage applied over the replaced head of the bone, with the shoulder drawn backward by a figure-of-eight bandage, or the patient is kept in bed in the recumbent posture and a compress held over the head of the bone by means of a bandage or strips of adhesive plaster. Fixation of the arm by a Velpeau bandage after it is allowed to get about is necessary to prevent reproduction of the deformity. Fixation dressings are maintained in this position for six or eight weeks, until adhesions have formed at the joint. More or less permanent deformity is often unavoidable, but standing this, however, the functional results obtained are satisfactory.

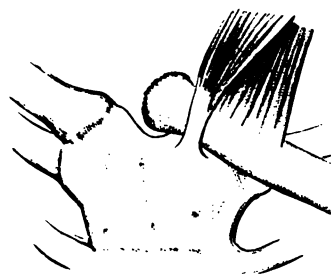
*Backward Dislocation.*—This may be produced by a blow to the anterior surface of the clavicle, when the

and drawing the shoulders upward and backward, when the bone will slip forward into its normal position. After the deformity has been reduced a compress should be placed over the articulation and held in position by adhesive straps, and the patient should be placed in bed upon a firm mattress. If confinement to bed is not possible, the use of a posterior figure-of-eight bandage to draw the shoulders backward, with a compress over the displaced end of the clavicle, is advisable. The dressings should be retained from six to eight weeks.

**Dislocation Upward.**—This is a rare dislocation, and usually results from indirect force applied to the shoulder or the acromial end of the clavicle.

**Symptoms.**—The most marked symptoms are a prominence above the top of the sternum (Fig. 162), depression of the shoulder, pain, and tenseness of the sternal origin of the sterno-cleido-mastoid muscle, which is stretched over the end of the displaced bone.

**Treatment.**—In reducing this displacement the arm should be drawn upward and outward, while the head of the clavicle is pressed downward into its articular cavity. A compress is then applied over the seat of injury and fastened in position by a roller bandage or by adhesive straps. If the deformity persistently recurs, the displaced bone should be exposed by an incision and secured in its normal position by silver wire sutures.



Dislocation of the sternal end of the clavicle upward. (Dennis.)

**DISLOCATIONS OF THE ACROMIAL END OF THE CLAVICLE.**—These are sometimes classified as dislocations of the scapula. There are three varieties: one in which the end of the clavicle is displaced upward from the acromion process; another in which the end of the clavicle is found below the acromion process; and one in which the clavicle takes a position below the acromion and coracoid processes. The first variety is the commonest. Dislocations of the acromial end usually result from force applied to the clavicle or to the acromion process of the scapula.

**Dislocation Upward.**—The acromial end of the clavicle can be felt as a projection above the acromion process, and there are dropping of the shoulder and more or less disability in the use of the arm (Fig. 163).

**Treatment.**—Reduction is usually not a matter of difficulty, and is accomplished by pushing the head of the humerus upward, at the same time making downward or slightly lateral pressure upon the



displaced acromial end of the clavicle. Great difficulty is often experienced, however, in maintaining reduction. A compress may be placed over the end of the clavicle, and the arm fastened to the side by a Velpeau bandage. A better method of retaining the end of

FIG. 163



Complete supra-acromial dislocation of the clavicle. (Stimson.)

the bone in place is that recommended by Stimson. It consists in applying a long strip of adhesive plaster three inches wide, the centre being placed over the flexed elbow and its ends carried up in front of and behind the arm, crossing over the end of the clavicle and being secured on the front and back of the chest respectively, while the bone is held in place by pressure upon the clavicle and the elbow. For additional security the forearm may be supported in a sling and the arm bound to the side of the chest (Fig. 164). Wiring the dislocated end of the bone in place has been practised with advantage. In cases in which in spite of the measures mentioned above there is tendency to persistence of deformity, I think it is well to cut down upon and expose the displaced bone and secure it in its normal position by silver wire sutures.

*Dislocation Downward.*—This is a comparatively rare accident

lial end of the clavicle passing between the acromion and processes.

*ms.*—The acromion process is abnormally prominent, and a gutter can be felt along its inner border, and the displaced

FIG. 164.



Dressing for supra-acromial dislocation of the clavicle. (Stimson.)

the clavicle may be felt under it; more or less disability of the arm is present.

*mt.*—Reduction is effected by manipulation, the bone being held in place by the application of a compress and adhesive straps and a peau bandage. Persistent redislocation is treated by wiring the bone in place.

*Acoid Dislocation of the Clavicle.*—This displacement is extremely rare, but a few cases have been reported. It is said to result from the shoulder being forced upward, and backward, while at the same time the acromial end of the clavicle is driven downward. The coracoid and coracoid processes are very prominent, and as a result there are pain and restricted motion of the arm, and an

increase in the distance between the sternum and the sun shoulder.

*Treatment.*—To facilitate reduction the arm should be brought to the side, and carried forcibly upward, inward, and to relax the clavicular portion of the pectoralis major muscle the clavicle is then grasped and disengaged from its position at the coracoid process, and pressed back into its proper position. After-treatment consists in confinement of the arm in this position by bandaging for from six to eight weeks.

**SIMULTANEOUS DISLOCATION OF BOTH ENDS OF THE CLAVICLE.**—This very unusual dislocation has occasionally been observed. It is the result of extreme violence, in which the shoulder is dislocated inward, the sternal end being usually dislocated forward and the acromial end upward.

*Treatment.*—Reduction may be accomplished by drawing the shoulder strongly backward and making pressure in the same direction over both the sternal and the clavicular ends at the same time; after reduction a compress should be applied to each end of the bone and secured in position by adhesive bandages, and the arm secured to the side. The dressing should be retained for six or eight weeks. The results obtained are quite satisfactory.

**Dislocation of the Inferior Angle of the Scapula.**—This has been used to describe the condition resulting when the inferior angle of the scapula slips from beneath the latissimus dorsi muscle. This accident occasionally occurs in children from lifting one arm.

**SYMPTOMS.**—There is prominence of the lower angle of the scapula which is increased by drawing the arm forward; pain and swelling of the arm may also be present.

**TREATMENT.**—To reduce this deformity the muscle should be relaxed by carrying the arm well backward, and when in this position manipulation with the fingers should be made to replace the bone. It may be found impossible to reduce the dislocation in these cases.





occasionally occur, either from force acting in a particular way or applied after one of the ordinary dislocations has occurred. Among the anomalous dislocations may be mentioned the *supra-acromial* and the vertical dislocation of the arm above the head, *luxatio erecta*.

**SUBGLENOID DISLOCATION.**—In this dislocation the capsular ligament is extensively torn on its lower surface, and the head of the humerus slips through it and takes a position on the anterior border of the scapula immediately below the glenoid cavity (Fig. 165). The head of the bone rests between the tendon of the triceps and the subscapular muscles. The axillary bloodvessels and nerves may suffer more or less from pressure, and the muscles surrounding the articulation also may be injured. It is not unusual in this dislocation

FIG. 167.



Skiagraph of subcoracoid dislocation of the humerus. (Case of Dr. T. S. K. Morton.)

for the deltoid muscle to be paralyzed from damage done to the circumflex nerve. The deformity in this variety is well shown in Fig. 166. This dislocation may follow a fall or a blow upon the anterior surface of the shoulder, or may be produced by force which drags the arm over the head. Violent muscular contraction may also produce it.

**SUBCORACOID DISLOCATION.**—In this variety, which is the most common of the shoulder dislocations, the rent is in the anterior surface of the capsular ligament and the head of the bone takes a position

the inner surface of the neck of the scapula below the coracoid process (Fig. 168). The deformity resulting is shown in Fig. 169.

**SUBCLAVICULAR DISLOCATION.**—Here the head of the bone rests on the side of the chest below the clavicle (Fig. 170), being covered by the pectoralis major and minor muscles,

supraspinatus and infraspinatus muscles, the acromial portion of the deltoid, with inner fibres of the coraco-brachialis muscle, the short and long head of the biceps, are upon the stretch. Compression of the artery vessels and nerves is common. Sub-

coracoid and subclavicular dislocations may result from any force which carries the arm directly backward and upward, pressing the head of the humerus against the inner part of the capsular ligament. They also result from blows or falls upon the outer surface of the shoulder.

**INFRA-SPINOUS DISLOCATION.**—In this form of dislocation the head of the humerus rests on the dorsum of the scapula behind the glenoid

FIG. 168.



Subcoracoid dislocation of the humerus. (Tillmanns.)

FIG. 169.



Subcoracoid dislocation of the left humerus. (Stimson.)

process and immediately below the spine of the scapula (Fig. 171). It is produced by force applied to the anterior surface of the shoulder.

**LUXATIO ERECTA.**—Among the rare and anomalous dislocations



of the head of the humerus is that known as *luxatio erecta*. The arm is held in a vertical position, the forearm resting on the top of the head, being held there by the patient to escape the pain caused by lowering it.

**SUBLUXATION OF THE HEAD OF THE HUMERUS.**—A condition described as subluxation of the head of the humerus is one which is distinguished by a depression beneath the acromion upon the posterior aspect of the joint, and a well-rounded prominence formed by the

FIG. 170.



Dislocation of the humerus downward under the clavicle.

FIG. 171.



Subspinous dislocation of the head of the humerus.

head of the humerus lying in contact with the coracoid process. The real nature of the injury is found in a *rupture or displacement of the long tendon of the biceps muscle*, in consequence of which the supraspinatus muscle draws the bone out of its normal position.

**SUPRACORACOID DISLOCATION.**—In a few cases of dislocation of the head of the humerus the upper end of the bone has occupied position above the coracoid process, in the interval between the acromion and the coracoid process, in front of the clavicle and usually above its level. The arm lies by the side of the body, and is directed rather backward. Reduction is effected by traction upon the arm and by elevation of the elbow.

*Symptoms.*—The signs of dislocation of the head of the humerus which are common to all varieties are an alteration in the shape of the shoulder; the rotundity of the shoulder is replaced by flattening; the acromion process becomes abnormally prominent, and beneath this the fingers can detect a marked depression. The elbow stands off from the body, except in subspinous dislocation, and it will be found impossible to place the hand of the injured limb upon the

ence of pressure upon the axillary nerves.

*Diagnosis.*—The diagnosis of dislocation of the head of the humerus is not difficult if the patient is seen soon after the injury; however, much swelling has occurred, the difficulty of determining the nature of the injury is often much increased. Therefore in these cases it is wise to administer an anæsthetic and make a careful methodical examination of the joint to determine the presence or location of fracture of the neck of the humerus, or to demonstrate the association of these two injuries. In a case of injury of the shoulder-joint, in which the arm rests against the side of the body and can be moved freely, if *Dugas's test* is also applied, and if the arm cannot be thrust into the space beneath the acromion process, the possibility of dislocation can be dismissed. Dislocation of the head of the humerus may be confounded with fracture of the neck of the humerus, of the neck of the scapula, or of the acromion. In all these cases there will be preternatural mobility, crepitus, and ease of motion, with a tendency to recurrence of the deformity as soon as the limb is released from the reducing force. In dislocation the arm stands out prominently, the shoulder is flattened, the arm is out from the side of the body, the fingers can be thrust in a distance under the acromion, the head of the bone can usually be felt in an abnormal position, and there is pronounced rigidity of the arm. Fractures of the surgical neck of the humerus or separation of the epiphysis there may be a prominence in front of the shoulder, a change in the shape of the shoulder, the position of the arm, the mobility are entirely different from those observed in cases of dislocation.

*Treatment.*—All the principal methods in vogue for reduction of dislocation of the humerus depend either on manipulation, or extension, or counter-extension, or a combination of the two.



manipulations are painful, and the muscular resistance is often marked that it is wise to administer an anæsthetic. In reducing a dislocation of the humerus by manipulation, the patient should be placed in the recumbent position and anæsthetized. The forearm

FIG. 172.



Kocher's method of reduction by manipulation: first movement outward rotation.

is next flexed upon the arm, to relax the long head of the biceps muscle. The arm is next grasped at the elbow and abducted, and raised so as to bring it to the side of the patient's head, thus relaxing the coracobrachialis and supraspinatus muscles. The surgeon should next place

FIG. 173.



Kocher's method of reduction: second movement, elevation of the elbow. (Cep)

his fingers of the other hand upon the head of the humerus, which can be felt under the skin in the axilla, and as the arm is drawn out and brought to a right angle with the chest the head of the humerus is lifted into its socket.

*Kocher's Method.*—In reducing a dislocation of the head

bow should be carried well forward and upward (Fig. 173); the arm should next be rotated inward, and the elbow lowered (Fig. 174).

FIG. 174.



Waller's method of reduction: third movement, inward rotation and lowering of the elbow.  
(Ceppel.)

Sometimes it may be of use to have an assistant press the head outward with the fingers or by a band in the axilla during the latter manipulation.

*Reduction by Extension and Counter-extension.*—The reduction of the humerus by extension and counter-extension may sometimes be practised with success. This method consists in making counter-extension by placing the heel in the axilla while traction is made downward from the arm or the forearm by the hands or an assistant (Fig. 175). The principal risk in this method is

the arm from the elbow (Fig. 176). With this manipulation the head of the bone may be slipped into its socket; but if this does not occur while the extension is maintained the limb should be rotated

FIG. 175.



Reduction of dislocation of the humerus by heel in the axilla. (Erichsen.)

and carried a little off from the body, and an assistant should press the head of the bone upward and outward toward the articular cavity, while the arm, still strongly extended as before, is brought

FIG. 176.



Mothe's method of reduction of dislocation of the humerus by extension upward.

down to the side. The reduction of *luxatio erecta* is usually easily accomplished by traction upward without changing the attitude of the limb until the head of the bone has been drawn into its socket.

*After-treatment.*—The after-treatment of all dislocations of the shoulder consists in the arm being fixed against the side of the body and the forearm carried in a sling for a week or ten days, or a V



erous have been reduced after months or even years ; but, as a rule, the older the dislocation the greater the difficulty in its reduction, and the manipulations may be accompanied by risk of injury to the axillary vessels ; this is particularly the case if marked inflammatory action followed the original displacement of the bone, or if adhesions are present between the head of the bone and the soft parts in the axilla. The principal risks in the reduction of old dislocations of the humerus are rupture of the axillary artery or vein, laceration of the axillary plexus of nerves, and fracture of the neck or shaft of the humerus. If a patient has had the head of the humerus dislocated for several years, does not suffer from pain, and has regained a considerable amount of motion of the arm from the formation of a new articulation, it is not wise to attempt to replace it.

In unreduced dislocations of recent occurrence, however, no time should be lost before proceeding to attempts at reduction. The patient should be thoroughly anæsthetized, and the surgeon should grasp the arm at the elbow and first rotate the head of the bone freely, to break up any adhesions that may exist. After the adhesions have been thoroughly separated he should endeavor to reduce the dislocation by manipulation or by Kocher's method ; and if these fail, one of the various methods by extension and counter-extension should be resorted to.

*Rupture of the Axillary Artery.*—This accident has occurred during the reduction of old dislocations of the humerus. The signs which indicate this accident are a rapidly developed swelling in the axilla and under the pectoral muscles, absence of the pulse at the axilla, pallor of the face, and in some instances syncope. In such a case pressure should be applied to the subclavian vessel, and the axillary artery should be cut down upon and secured by ligatures on each side of the rupture.



bound firmly to the side; it is not unusual, although a large amount of blood may have escaped, to have the hemorrhage thus controlled and for the patient to go on to recovery. If this fails, the vein should be exposed and ligated.

*Injury of Nerves.*—The axillary plexus of nerves may be damaged in forcible attempts to reduce old dislocations of the humerus, the injury being followed by paralysis of the arm.

*Fracture.*—Fracture of the neck, head, or shaft of the humerus has occurred in the manipulations practised to reduce old dislocations of the humerus. If fracture occurs high up in the bone, no further attempts can be made to reduce the dislocation; and instead of treating the fracture by immobilization in the usual manner, the patient should be encouraged to use the arm, with the idea of a false joint forming at the seat of fracture, giving him a wider range of motion.

**DISLOCATION OF THE HUMERUS WITH FRACTURE OF THE NECK OF THE HUMERUS.**—These accidents may occur simultaneously. The diagnosis of this injury can usually be made by discovering that the head of the bone occupies an abnormal position and at the same time does not move with the shaft; crepitus may also be elicited. The deformity of the shoulder is that of dislocation, but Dugas's test will fail, as the arm is movable and the elbow can be brought into contact with the chest.

*Treatment.*—The patient should be anæsthetized, and the head of the bone pressed back into the glenoid cavity with the fingers, after which the fracture should be dressed in the manner described for the treatment of fractures of the surgical neck of the humerus. If it is found impossible to reduce the displaced head of the bone, it should be exposed by incision, the capsule freely incised, and after reduction of the head of the bone the fragments wired. If this is not possible, excision of the head of the bone should be practised.

**COMPOUND DISLOCATION OF THE HUMERUS.**—In some cases of dislocation of the humerus the head of the bone has been driven through the soft parts, causing a compound dislocation. If the vessels remain uninjured and there is no fracture, the wound and the exposed head of the bone should be thoroughly sterilized, the bone reduced, and the wound closed. If the head of the bone, however, has been fractured, it is safer to excise it before attempting reduction. In cases of compound dislocation of the head of the humerus complicated with laceration of the axillary artery amputation at the shoulder-joint would probably be required in the majority of cases, although even here conservative treatment might be attempted, the vessel being tied, the dislocated bone replaced, and the wound dressed with a copious antiseptic dressing.

**SIMULTANEOUS DISLOCATION OF THE HEADS OF BOTH HUMERI.**

are similar to those observed following subcoracoid and subspiral dislocations. In congenital dislocations of the head of the humerus the upper arm is usually markedly atrophied, while the forearm retains its natural size. Treatment is not very satisfactory. One case has been reported in which the humerus was perfectly restored to its articulating cavity after repeated manipulations. Erb's paralysis has sometimes been confounded with this anomaly.

**Dislocations of the Bones of the Forearm.**—Dislocations of the bones of the forearm present a number of varieties: (1) the head of the radius may be dislocated from the humerus; (2) the head of the ulna may be dislocated from the humerus; (3) both radius and ulna may be dislocated from the humerus; (4) the inferior extremity of the ulna may be dislocated from the radius.

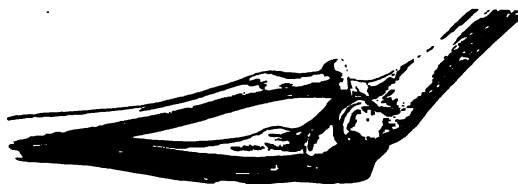
**RADIO-HUMERAL DISLOCATIONS.**—The head of the radius may be detached from the sigmoid cavity of the ulna, and be displaced forward, backward, or outward. In these dislocations the lateral collateral ligaments are torn, and the head of the bone rests in front of, behind, or external to the external condyle of the humerus. This is not an infrequent accident, and often escapes detection.

**FORWARD DISLOCATION OF THE HEAD OF THE RADIUS.**—This is the most common direction which the head of the radius takes, and the cause is usually a fall upon the hand while the latter is in a state of pronation, or force applied to the side of the elbow.

**Symptoms.**—The radial side of the forearm is shortened and inclined outward, and a depression exists immediately below the external condyle of the humerus. The head of the radius can be felt in front of the elbow, and may be recognized by placing the thumb upon it while pronating and supinating the forearm (Fig. 177). The biceps

the hand. The displacement can usually be reduced without much difficulty, but the bone is often redislocated upon making flexion or extension of the arm. After reduction the arm should be secured with the elbow flexed at a right angle by the application of a well-

FIG. 177.



Dislocation of the radius forward. (Dennis.)

padded anterior angular splint; a compress is also placed over the anterior surface of the head of the radius. This splint should be changed at intervals of two or three days, and worn for several

FIG. 178.



Dislocation of the head of the radius backward. (Cooper.)

weeks. All violent flexion, pronation, or supination of the forearm should be forbidden for a long time, as it is often a matter of some weeks before repair of the capsular ligament is sufficiently firm to prevent recurrence of the displacement. In cases in which the dislocation escapes detection and remains unreduced patient often regain very fair use of the arm, but may have some limitation in flexion of the forearm upon the arm. If an unreduced dislocation causes pain or interferes decidedly with the use of the arm, attempts should be made to reduce it; if this cannot be done, excision of the head of the radius should be practised, a section of the bone being made just above the insertion of the tendon of the biceps muscle. I have seen very satisfactory results follow this procedure in these cases.

**BACKWARD DISLOCATION OF THE HEAD OF THE RADIUS.**—This is a rare form of dislocation, in which the head of the radius escapes through the posterior portion of the capsular ligament and rests behind the external condyle of the humerus (Fig. 178). Its cause may be force applied to the front of the head of the radius or a fall upon the hand when the bones of the forearm are in extreme pronation.

*Symptoms.*—In this dislocation the forearm is slightly flexed; the hand is pronated, supination is impossible; a depression can be felt below the external condyle of the humerus, and the head of the

be located behind the condyle; flexion and extension of the forearm are also much diminished.

*Reduction.*—While the forearm is flexed an assistant makes traction from the arm, and the surgeon makes extension and, and by then supinating the forearm, brings the head of the bone forward toward the elbow cavity the reduction can usually be effected. After reduction the forearm and hand should be placed on an obtuse-angled splint, and should be worn for several weeks.

**POSTERIOR DISLOCATION OF THE HEAD OF THE RADIUS.**  
This is an extremely rare dislocation: the head of the bone rests upon the epicondylar ridge

*Symptoms.*—The symptoms are a prominence in front of the external condyle of the humerus, the forearm in a position between pronation and supination, and impairment in the power of flexion and extension of the forearm.

*Treatment.*—Reduction can be accomplished by traction and counter-extension when the arm is fully flexed, at the same time pressing the head of the bone downward and forward. The limb should be placed upon an angular splint, and the details of treatment applied as were advised for backward displacements.

**DISLOCATION OF THE ULNA FROM THE HUMERUS.**—In this dislocation the ulna is displaced backward upon the humerus, the head of the radius maintaining its normal position and the coronoid process resting upon the olecranon fossa or resting upon the posterior internal condyle of the humerus (Fig. 180).

FIG. 180.



Dislocation of the upper end of the ulna backward.

*Treatment.*—The treatment of this dislocation is the same as that described for dislocation of both bones of the forearm.

FIG. 179.



Dislocation of the head of the radius outward.



**DISLOCATION OF THE RADIUS AND ULNA.**—The upper ends of the radius and ulna may be dislocated together, and this dislocation may take place in a backward, forward, outward, or inward direction.

FIG. 181.



Dislocation of the radius and ulna backward.

*Backward Dislocation of the Radius and Ulna at the Elbow.*—This is one of the most common dislocations at the elbow-joint, and results from force directly or indirectly applied to the hand and forearm. The anterior and lateral ligaments are usually torn, the coronoid process of the ulna drops into the olecranon fossa of the humerus, and the radius occupies the posterior surface of the external condyle; the tendons of the biceps and the brachialis anticus muscles are stretched over the articular surface of the humerus (Fig. 181).

FIG. 182.

Dislocation of the elbow backward.  
(Stimson.)

*Symptoms.*—The symptoms of this location are shortening of the anterior surface of the forearm, a marked prominence in front of the elbow, caused by the lower extremity of the humerus, a prominence behind the elbow (Fig. 182) caused by the olecranon process of the ulna and the tendon of the triceps; elbow is rigid, and flexion and extension are difficult.

*Diagnosis.*—Posterior dislocation of the elbow must be diagnosed from fractures of the condyles of the humerus and supracondyloid fracture of the humerus, with which they are frequently confounded. This mistake will not occur if the following points are kept in mind. In dislocation there is rigidity of the elbow, with a prominence in front of the elbow and another behind the elbow. The relative position of the olecranon process and the two condyles of the humerus is disturbed in dislocation.

olecranon process being behind the condyles, but is not in which the three bony points remain in line. The position in dislocation is increased by flexion and diminished in extension, whereas in fracture the posterior projection is diminished and increased by extension. In dislocation crepitus is obtained in fracture it can be obtained. In fracture the deformity is removed upon extension and counter-extension, but reappears as the force is removed; in dislocation, when the deformity is produced by extension and counter-extension, there is no reproduction.

*Reduction.*—Reduction in recent cases is usually very easy, especially when muscular resistance is removed by the administration of an anæsthetic.

It may be accomplished by fixing the arm and flexing the elbow, and then making traction, the knee being sometimes placed at the bend of the elbow; or the same result may be obtained by extending the arm and bringing the forearm into extension, when traction and sudden flexion the bones will slip into position. After reduction the arm should be placed upon a well-padded angular splint, which is retained for two or three weeks, the first week passive movements and massage being practiced to prevent stiffness of the joint.

*Dislocation of the Radius and Ulna.*—This is a rare form of dislocation, in which the radius and ulna occupy a position in front of the condyles of the humerus (Fig. 183). In complete dislocation the radius and ulna are forced forward the face of the humerus can be felt, and the olecranon process and the head of the radius anteriorly.

*Reduction.*—This dislocation may be reduced by making forced flexion of the elbow, and at the same time extension of the forearm.

#### *Dislocations of both Bones of the Forearm.*

*Lateral Dislocations.*—Lateral dislocations of the forearm are rare injuries: with few exceptions incomplete, and are produced by a blow striking upon the lower and the upper arm in opposite directions.

In incomplete outward dislocation the ulna is not moved from the articular surface of the humerus; the radius either remains in contact with the outer margin of the head of the humerus or rests between the latter and the epicondyle (Fig. 184). When the dislocation is more complete the head of the radius may be entirely external to the external condyle.

FIG. 183.



Forward dislocation of the elbow; Canton's case.



condyle, while the outer articular surface of the humerus occupies the sigmoid cavity of the ulna (Fig. 185). In inward dislocation the ulna rests upon the internal condyle, and the head of the radius may be in the great sigmoid cavity or upon its anterior or posterior surface.

FIG. 184.



Incomplete outward dislocation.  
(Poutmet.)

FIG. 185.



Complete outward dislocation of the elbow  
supra-epicondylar. (Stimson.)

The ulna may also take up a position behind the internal condyle of the humerus, while the radius occupies the olecranon cavity, constituting a postero-lateral dislocation.

*Symptoms.*—The arm is flexed and inclined inward or outward. The internal or external condyle is covered by the projection of the olecranon process of the ulna or the radius, the external condyle is more prominent from the absence of the head of the radius, and the hand is pronated.

*Treatment.*—Reduction of these dislocations is accomplished by grasping the forearm with one hand and the arm with the other, making extension and counter-extension while forcing the humerus and the bones of the forearm in opposite directions.

*Postero-lateral* dislocations should be treated as posterior dislocations, by bending the front of the elbow around the knee, and flexion and extension conjoined with lateral pressure. The treatment of these dislocations is similar to that employed in posterior dislocations of the elbow.

*Divergent Dislocation of the Radius and Ulna.*—This variety of dislocation at the elbow-joint is exceedingly rare. Both bones are displaced, but do not follow the same direction; the ulna may be displaced backward and the radius forward (Fig. 186).

the ulna may be dislocated to the inner side and the radius to the outer side of the condyles. The diagnosis of these injuries is not often difficult after a careful examination.

*Treatment.*—Reduction can usually be accomplished without difficulty by making extension from the forearm and by manipulation.

**SUBLUXATION OF THE HEAD OF THE RADIUS.**—This is a form of displacement which is observed in young children, and usually results from forcible pulling and twisting of the forearm. It is not an uncommon accident. I have seen a number of cases, principally in dispensary practice. Hutchinson considers the condition due to the head of the radius slipping out of the grasp of the orbicular ligament. The arm rests against the side of the body, is partly flexed at the elbow, and is pronated. There is tenderness upon pressure over the head of the radius, and the patient refuses to use the arm (Fig. 187).

FIG. 186.



Divergent dislocation of the elbow (dislocation of the ulna backward and of the radius forward). (Tillmanns.)

FIG. 187.



Subluxation of the head of the radius. (Pingaud.)

*Treatment.*—The surgeon seizes the arm with one hand and the wrist with the other, and upon making supination a sharp click is heard or felt and the function of the joint is restored. The after-treatment consists in fixation of the elbow-joint for a few days.

**OLD DISLOCATIONS OF THE ELBOW.**—If the attempts at reduction are postponed for a week or longer, it may be difficult or impossible to return the bones to their normal position. The patient should be anesthetized, and, the adhesions being broken up so that the motions of flexion and extension can be freely made, attempts should be made to reduce the dislocation by manipulation. If these fail, the dislocation may be allowed to remain unreduced; or if the dis-



placement of the bones is accompanied with pain, or the patient's arm is useless by reason of the limited motion, excision of the elbow may be resorted to, with a view to giving the patient increased motion, although a certain amount of weakness in the arm may result after the operation.

**COMPOUND DISLOCATIONS OF THE ELBOW.**—Compound dislocations of the elbow are serious injuries, but if the bloodvessels have not been torn the possibility of saving the limb is good. In their treatment the skin and the wound should be thoroughly sterilized, and the surgeon may either reduce the displaced bone or, what seems to me the wiser procedure, make a partial excision of the joint; that is, if possible, remove the lower portion of the humerus and allow the articular surface of the ulna to come in contact with the sawn surface. In compound dislocations of the elbow associated with fracture no definite rule can be given for excising certain portions of the bones, the rule in such cases being to remove the fragments involved in the fracture rather than to practise a formal excision. After removing the necessary amount of bone the wound should be drained and closed, a copious antiseptic dressing applied, and the arm secured upon an internal or an anterior angular splint. If the surgeon has succeeded in preventing infection of the wound, the repair in these cases is often very prompt, and the functional results following partial excision when associated with fracture I think are superior to those following simple reduction of the displaced bone.

**DISLOCATION OF THE INFERIOR RADIO-ULNAR ARTICULATION.**—This dislocation consists in a separation of the lower extremity of the ulna from the semilunar cavity of the radius. The ulna may be displaced either backward or forward, and the injury is often associated with fracture of the lower end of the radius.

*Backward Dislocation.*—This usually results from extreme and violent pronation of the hand, and a fracture of the carpal extremity of the radius may be simultaneously produced. The posterior radio-ulnar and sacciform ligaments are often ruptured, and the triangular interarticular cartilage is disconnected at its apex from the root of the styloid process of the ulna.

*Symptoms.*—Examination will show the presence of a movable prominence at the inner side of the back of the wrist, the styloid process of the ulna being no longer in line with the fifth metacarpal bone. The hand is supinated and the fingers are flexed.

*Treatment.*—The hand should be extended, to relax the extensor carpi ulnaris muscle, while the displaced bone at the same time is pressed directly backward into the semilunar cavity. There is often a strong tendency to the reproduction of the displacement, which can be counteracted by the use of a firm compress placed over the po-

**terior** surface of the bone, and the application of a straight padded or **Bond** splint; this should not be removed permanently for three or four weeks. The wrist should be supported by strapping with adhesive plaster or the use of a compress and bandage for a long time.

*Forward Dislocation.*—This dislocation is caused by violent supination of the hand, and is usually accompanied by rupture of the anterior ligaments of the joint.

*Symptoms.*—Here the prominence is on the palmar surface of the wrist, somewhat to the radial side, and it will be noticed that the normal prominence of the lower end of the ulna at the back of the wrist is absent; the hand is supinated.

*Treatment.*—Extension is made from the hand and counter-extension from the arm, while the forearm is held in the flexed position. By forced pronation, and by pressing the head of the ulna backward, it may be made to take its natural position in the semilunar cavity of the radius. The after-treatment consists in the application of two well-padded straight splints to the front and back of the forearm, the dressing being similar to that employed in fractures of both bones of the forearm. These splints should be retained for about four weeks.

**DISLOCATIONS OF THE WRIST.**—These are comparatively rare injuries; they may be either backward or forward.

*Diagnosis.*—Dislocation of the wrist is most likely to be confounded with fracture of the lower end of the radius, but may easily be distinguished from this injury if the surgeon observes the following points: fracture at the lower end of the radius presents somewhat the same deformity, but the wrist-joint itself is movable, and there is a strong tendency to recurrence of the deformity upon removal of the correcting force. In dislocation, on the contrary, there is rigidity of the wrist-joint, and, after reduction has been accomplished, upon the withdrawal of the extending force there is no tendency to reproduction of the displacement.

*Posterior Dislocation of the Wrist.*—This displacement follows the application of force to the back of the hand sufficient to cause extreme flexion and rupture of the posterior radio-carpal and lateral ligaments, allowing the carpus to rest upon the posterior surface of the radius and ulna. The most marked symptom is deformity, which consists in thickening in the antero-posterior diameter of the wrist, and fixation of the wrist with the hand slightly extended and the fingers flexed (Fig. 188).

*Treatment.*—The displacement is reduced by grasping the hand of the patient and making extension, combined with and followed by slight flexion, abduction, and adduction. There is no tendency to

reappearance of deformity, and the application of a straight splint, worn for several weeks, will be sufficient.

*Anterior Dislocation of the Wrist.*—This displacement follows force applied to the hand in the direction of extension: the anterior carpal and lateral ligaments are ruptured, and the bones of the carpus rest upon the anterior surface of the radius.

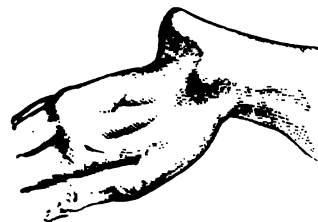
*Symptoms.*—The symptoms of this displacement are fixation of the hand in the extended position; the lower ends of the radius and ulna form a decided prominence on the back of the wrist (Fig. 189).

FIG. 188.



Dislocation of the wrist backward.  
(Hamilton.)

FIG. 189.



Dislocation of the wrist forward.  
(Hamilton.)

*Treatment.*—Reduction is accomplished by making extension from the hand with counter-extension from the arm, at the same time the carpus being extended upon the forearm and the ends of the ulna and radius pressed forward. Afterward the hand and forearm should be placed upon a well-padded straight splint, or upon a Bond splint and secured by the application of a roller bandage.

*Compound Dislocations of the Wrist.*—These are serious injuries and are often associated with extensive laceration of the adjacent skin, ligaments, and tendons. When the integrity of the vessels and nerves is preserved amputation may often be avoided, even in spite of extensive comminution of the bones and laceration of the soft parts. In cases in which there is extensive comminution of the bones the loose fragments should be removed, an informal excision being practised. After reducing the displacement the part should be placed upon a well-padded palmar splint and a copious antiseptic dressing applied. In cases in which rupture of nerves or tendons is associated with this injury these should be approximated with sutures, and important vessels, if injured, secured by ligatures.

*Dislocations of the Bones of the Hand.*—**DISLOCATION OF THE CARPAL BONES.**—Displacements of single bones of the carpus are rare, from the fact that the bones are bound together by strong ligaments. Those most liable to be dislocated are the os magnum and the semilunar and the pisiform bones.

*Dislocation of the Os Magnum.*—This is recognized by a pron

mediately behind the carpal extremity of the third metacarpal bone. It is reduced by pressing the bone back into place, and a compress should be applied over it, and the hand and wrist placed upon a well-padded splint.

*Dislocation of the Semilunar Bone.*—This injury is characterized by the presence of a hard body on a line with the metacarpal bone of the index-finger and below the posterior margin of the carpal bone of the radius. It is reduced by making extension from the wrist and pressing the bone forward and upward; the hand and wrist should then be placed upon a palmar splint.

*Dislocation of the Pisiform Bone.*—When this occurs the bone is displaced from the cuneiform bone and drawn upward, and often can be felt as a hard mass above the wrist. In reducing this dislocation the hand should be flexed and the displaced bone drawn downward and the hand fixed upon a splint in the flexed position. *Partial dislocations of the carpus* are occasionally seen, the bone being displaced backward, forward, or laterally.

The treatment of these cases has not, as a rule, been satisfactory; but in every case an attempt should be made as soon as the deformity is noticed to secure fixation of the wrist in its normal position by means of mechanical appliances which will allow of motion in all directions and yet prevent displacement of the bones.

**DISLOCATION OF THE METACARPUS.**—Dislocation of the metacarpus as a whole is extremely rare. The accident will be recognized by the swelling on the back and front of the hand, with shortening of the fingers.

*Treatment.*—Reduction is accomplished by extension and counter-extension with manipulation, after which the hand and forearm should be placed upon a palmar splint with a compress applied over the metacarpal joints.

**DISLOCATIONS OF THE METACARPAL BONES.**—These are generally compound. The soft parts are likely to be extensively lacerated, and in some cases amputation may be demanded. If, however, the soft parts have not been extensively injured, the bones should be reduced by a combination of extension and counter-extension, and after dressing the wound the hand and forearm



of the metacarpal bone back into place. The tendency to reproduction of the deformity is usually marked, and to prevent this a moulded binders' board splint should be fitted to the thumb and wrist, and secured by a narrow roller bandage.

**DISLOCATIONS OF THE THUMB.**—The most common dislocation of the thumb is a displacement, either forward or backward, of the proximal phalanx.

**Backward Dislocation.**—This dislocation usually results from force applied to the phalanx while it is in a state of flexion, causing a displacement of the proximal end of the phalanx behind the head of the metacarpal bone; it may be complete or incomplete. This displacement is one which presents marked deformity (Fig. 190), and

FIG. 190.



Posterior dislocation of the proximal phalanx of the thumb. (Tillmanns.)

FIG. 191.



Dislocation of the metacarpo-phalangeal joint of the thumb.

its reduction is often attended with great difficulty. The difficulty in reduction seems to arise from the fact that the neck of the metacarpal bone is grasped between the heads of the short flexor of thumb (Fig. 191).

**Treatment.**—This displacement may sometimes be reduced by flexing the metacarpal bone of the thumb, and overextending the thumb, and then drawing it downward and suddenly flexing it, by which manipulation the displaced bone may slip into place. In other cases, in spite of all manipulations, it may be found impossible to reduce the deformity without operation; one head of the short flexor should then be divided subcutaneously, when by making the foregoing manipulations the displacement may be reduced, or the displaced bone may be exposed by an incision, and any structures which interfere with its reduction divided and the displacement reduced.

**DISLOCATIONS OF THE PHALANXES OF THE FINGERS.**—These may be metacarpo-phalangeal or interphalangeal. Reduction is not usually difficult, and can be accomplished by over-extension of the distal phalanx, followed by manipulation and flexion (Fig. 192). The after-treatment consists in fixing the displaced bone by the application of a moulded binders' board splint for two or three weeks, and later in practising passive motion to restore the function of the joint.

*Compound Dislocation of the Phalanges.*—In compound dislocations of the phalanges the wound should be thoroughly sterilized, the

FIG. 192.



Reduction of metacarpo-phalangeal dislocation of the index finger. (Hamilton.)

dislocation reduced, the wound closed, and the parts fixed by a moulded binders' board splint. Where there is extensive comminution of the bones in conjunction with dislocation of the phalanges excision of the comminuted portions should be practised.

**Dislocation or Diastasis of the Bones of the Pelvis.**—Diastasis of the bones of the pelvis results from heavy bodies passing over the pelvis, or from crushing forces such as occur in railway accidents, and is often associated with fracture of the pelvic bones. The most common seat of diastasis of the pelvis is at the sacro-iliac or the pubic symphysis.

*Symptoms.*—The patient is unable to stand, and complains of a sense of falling apart in the region of the pelvis, and upon examination, by grasping the bony prominences of the pelvis and making motion, mobility can usually be felt at the region of separation.

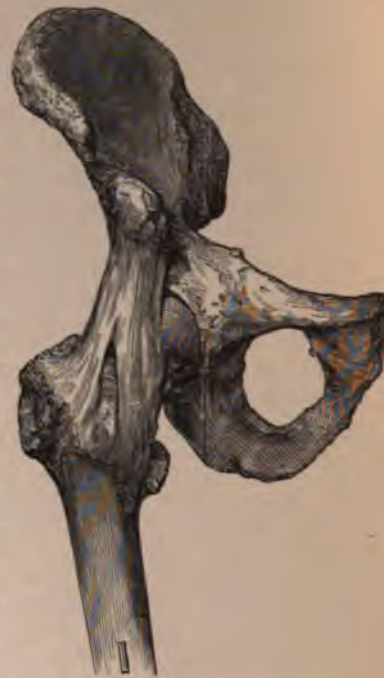
The treatment of pelvic diastasis consists in placing the patient in bed upon his back on a firm mattress, and, after reducing the displacement by manipulation surrounding and supporting the pelvis with a strong muslin binder or with broad strips of adhesive plaster. This support should be retained for a period of a month or six weeks; at the end of this time union is sufficiently firm to allow the patient to get up and walk about.

**DISLOCATION OF THE COCCYX.**—This injury may result from force received directly upon the region of the coccyx, and consists in a forward displacement of this bone. The amount of pain and disa-

bility following the anterior displacement of the coccyx is out of proportion to the extent of the injury. This injury may be diagnosed by introducing the finger into the rectum, when the coccyx can be easily felt to be pushed forward. Its reduction is accomplished without difficulty by manipulation with a finger in the rectum. The displacement is, however, very likely to recur, and if it is accompanied with much disability and pain excision of the coccyx is to be recommended.

**Dislocations of the Hip.**—Dislocations of the hip have been observed at all ages, but are most frequent in adult life, and are more common in males than in females. The head of the femur may be primarily displaced in one of four directions—*upward, backward, downward, or forward*; and may also undergo a number of secondary displacements. The mechanism of dislocations of the hip has been very carefully described by Bigelow, who considers that the typical displacements of the hip result when the ilio-femoral, or Y-ligament remains untorn in whole or in part. The Y-ligament consists of a mass of fibrous tissue composed of two branches, which have a common origin from the anterior inferior spinous process of the ilium, the external portion being inserted into the outer part of the anterior intertrochanteric line, and the inner part into the internal portion of the same ridge. This ligament serves to reinforce anteriorly the capsule of the hip-joint (Fig. 193). Bigelow held the opinion that typical dislocations of the hip resulted when both branches of the Y-ligament remained untorn, and that in an atypical or irregular dislocation both branches of the Y-ligament were ruptured, the head of the bone then occupying almost any position intermediate to the regular ones. Allis holds that the head of the bone in all dislocations of the hip escapes from the lower segment, and when outward is first dorsal, and then may be displaced upward or downward; when inward is first thyroid, and then may be displaced upward or downward.

FIG. 193.



The ilio-femoral, or Y-ligament. (Bigelow.)



**DISLOCATION OF THE HIP UPWARD AND BACKWARD (ILIAC).—**In this dislocation the head of the femur rests upon the dorsum of the ilium (Fig. 194). It may result from falls upon the knee or the foot when the limb is adducted, or from force applied to the back when the pelvis is flexed upon the thighs, or from forcible twisting of the pelvis while the foot and thigh remain fixed.

*Symptoms.*—The symptoms of iliac dislocation of the hip are flexion and adduction of the thigh, marked prominence of the great trochanter, inversion of the foot, and fixation or rigidity of the hip-

FIG. 194.



Dislocation of the femur upon the dorsum illi. (Dennis.)

joint. There is also marked shortening of the limb, varying from one to three inches, and the head of the bone in certain cases may be felt in its abnormal position.

*Diagnosis.*—Iliac dislocation of the hip is often confounded with fracture of the neck of the thigh-bone, but little difficulty should be experienced if the surgeon bears in mind the facts that in dislocation of the hip the trochanter is very prominent, the knee is adducted, the limb flexed, and the foot inverted, that there is no crepitus, and there is immobility at the hip-joint; the limb cannot be restored to its proper length by the application of ordinary force, and when the deformity is once reduced it does not tend to recur. In fracture of the neck of the femur the trochanter is not prominent, the foot is inverted, the knee is not adducted, and the limb is not flexed;



crepitus can often be obtained, and there is preternatural motion at the hip-joint. Extension restores the limb to its proper position, but upon the removal of the extending force the shortening returns.

**DISLOCATION OF THE HIP BACKWARD (ISCHIATIC).**—This is a rare dislocation, which Bigelow describes as dorsal below the level of the obturator internus muscle, the head of the bone is displaced

FIG. 195.



Dislocation of the femur backward into the ischiatic notch. (Dennis.)

the sacro-sciatic notch (Fig. 195). This dislocation results from a blow applied to the knee, foot, or pelvis when the thigh is flexed upon the pelvis.

*Symptoms.*—In this dislocation the limb is slightly flexed, abducted, and the knee is turned toward its fellow. The knee touches the thigh at the inner margin of the patella (Fig. 196).

ning is rarely more than half an inch; the hip is less prominent and the trochanter is farther from the anterior superior spinous process of the ilium than in the dorsal dislocation, and the bone is less movable and it occupies a lower position.

*Reduction.*—Reduction of iliac and ischiatic dislocations may be accomplished by manipulation or by extension and counter-extension, the former being the method in common use. In reduction by manipulation the patient is placed upon his back upon a mattress and anesthetized; the surgeon grasps the ankle of the injured limb with one hand and the front of the knee with the other; the leg is flexed on the thigh, and the thigh on the pelvis. Flexing the thigh in iliac dislocations relaxes the ilio-femoral ligament, and in ischiatic dislocations disengages the head of the femur from the obturator internus muscle. It is then adducted and carried to the sound side, rotated slightly outward, and finally, by external circumduction swept across the abdomen and brought in a straight position beside its fellow (Fig. 197). Adduction brings the head of the

FIG. 197.



Reduction of backward dislocation of the femur.

(.)

bone close to the articular cavity, while external rotation and circumduction shorten the outer branch of the ilio-femoral ligament and raise the head of the bone over the acetabulum. Under this manipulation the head of the bone usually slips into the acetabulum.

Allis in the reduction of dorsal dislocations recommends that while the patient is supine the surgeon kneel beside him, and, in the case of the right hip, grasp the ankle with the right hand and place the bent elbow of the left arm beneath the knee. He then turns the bent leg outward by means of the ankle and lifts it, and next turns the leg inward and brings the femur down in position.

*Reduction by Extension and Counter-extension.*—Reduction by extension and counter-extension by the use of the pulley and extend-

FIG. 196.



Backward dislocation of the femur. (Tillmanns.)



ing bands was that in common use before the introduction of manipulation. This method is not often practised at the present time, as by its use much greater violence is done to the parts. On the whole it is not so satisfactory as the treatment by manipulation, which is based on a study of the anatomy of the parts. It may, however, be required in some cases of old dislocation of the femur.

**DISLOCATION OF THE HIP DOWNWARD AND FORWARD (ANTERIOR).**—In this dislocation the head of the bone, after escaping from the acetabulum, lodges over the thyroid foramen upon the obturator foramen.

FIG. 198.



1, dislocation of the femur into the obturator foramen. 2, dislocation of the femur into the pubis. (Dennis.)

externus muscle (Fig. 198, 1). It is produced by force acting upon the limb while it is in a state of abduction.

*Symptoms.*—The limb is lengthened about an inch and a half, the heel is raised, and the foot may be slightly everted; the hip is stiffened, and the body inclined forward on the pelvis and toward the injured side (Fig. 199). The head of the bone may be felt below the horizontal ramus of the pubis.

*Treatment.*—The leg should be flexed upon the thigh, and the thigh carried up to a right angle with the pelvis. The limb is then abducted and rotated inward, and carried across the abdomen to the sound side, and brought down in the position of adduction. On the sound side of its fellow, the manipulations being the reverse of those described for the reduction of backward dislocation (Fig. 200). During att

at the reduction of thyroid dislocations it is quite common for the head of the bone to pass below the acetabulum and thus convert the

FIG. 199.



Deformity in obturator dislocation of the femur. (Johnson.)

thyroid into an ischiatic or an iliac dislocation, in which event the reduction may be accomplished by adopting the manipulations described for the reduction of the latter. To prevent this complication during the reduction of thyroid dislocations a folded towel may be placed beneath the upper part of the thigh, and by raising the latter at the moment the limb begins to descend the head of the bone may be prevented from slipping below the acetabulum.

DISLOCATION OF THE HIP UPWARD AND FORWARD (PUBIC).—This is the rarest of the primary regular dislocations. The head of the bone after escaping from the

FIG. 200.



Reduction of downward and forward dislocation of the femur. (Bigelow.)

acetabulum rests upon the pubis internal to the pubic eminence (Fig. 198, 2). The injury results from falls upon the foot or upon the knee, when the thigh is thrown behind the perpendicular, or by violent twisting of the limb.

*Symptoms.*—The limb is shortened and abducted, the thigh is flexed, the foot is everted, the head of the bone can be felt in front of the pubis, and the trochanter is not prominent (Fig. 201). This form of dislocation is also likely to be confounded with fracture of



the neck of the femur. In fracture of the neck of the femur there are crepitus and mobility; the thigh is not flexed nor abducted. In

pubic dislocation there are absence of crepitus, immobility, abduction and flexion of the thigh, and the head of the bone can be felt in front of the pubis.

*Treatment.*—The leg should be flexed on the thigh, and the thigh on the pelvis, to its fullest extent, so that it shall be brought in contact with the abdomen, which manipulation relaxes the ilio-femoral ligament and dislodges the head of the bone from the pubis. The limb is then rotated inward, carried across toward the sound side, and brought down again. Allis, in the reduction of anterior or inward dislocations, recommends flexing the thigh, then adducting it, carrying the knee obliquely inward and downward, and then rotating it outward.

#### ANOMALOUS DISLOCATIONS OF THE HIP.

—As before stated, anomalous or atypical dislocations are likely to result where both branches of the ilio-femoral, or Y-ligament have been ruptured. In these the head of the bone assumes a number of different positions. Anomalous dislocations of the hip are



Deformity in pubic dislocation of the femur. (Bigelow.)

classified as those which occupy a position above the level of the acetabulum, *upward*, and those below the level of the acetabulum, either downward or forward, *subpubic*.

*Dislocation of the Hip directly Upward (Supracotyloid).*—In this dislocation the head of the bone is displaced upward, and rests a little to the side of the anterior superior spine of the ilium. *Reduction* effected by flexion and abduction of the limb.

*Dislocation Downward upon the Tuberosity of the Ischium.*—This dislocation is rare. The limb is flexed, and may be somewhat abducted and everted. *Reduction* is usually accomplished without much difficulty by traction and flexion.

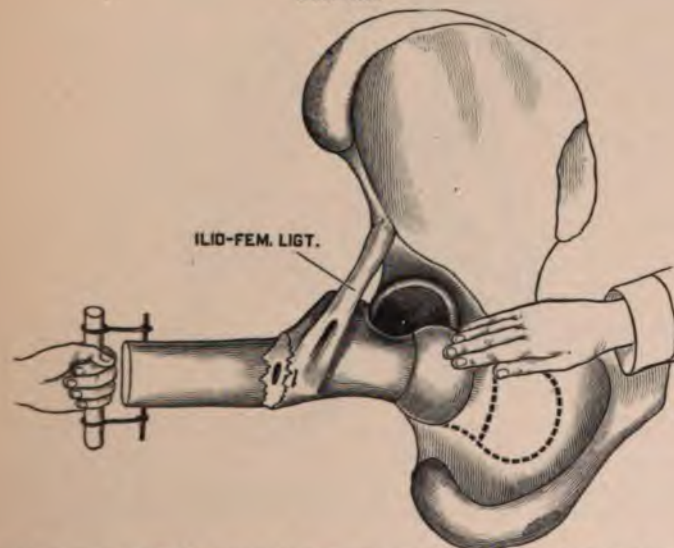
*After-treatment of Dislocation of the Hip.*—The after-treatment of dislocation of the hip consists in confinement to bed for two or three weeks, the limb being immobilized by sand-bags or by simply bandaging the knees together. At the expiration of this time the rent in the capsule will have been healed and the patient can begin to use the limb.

*Complications in Dislocations of the Hip.*—Dislocations of the hip

may be complicated by fracture of the lip of the acetabulum, which renders the reproduction of the dislocation likely after reduction. Fracture of the neck of the femur may also occur in attempts to reduce a dislocation. In the event of such an accident efforts should be made to replace the head of the bone in the acetabulum by manipulation, but this is not likely to be successful, and the case should be treated as one of fracture of the neck of the femur, when a fairly useful limb may result, or excision of the head of the bone may be practised.

Allis in dislocations of the femur accompanied by fracture of the neck of the bone recommends that the reduction be accomplished by using the connection between the fragments, which is partly periosteal, partly tendinous, and partly muscular, in making traction upon the

FIG. 202.



showing first stage of Allis's method of reducing forward dislocations of the femur complicated with fracture. (Allis.)

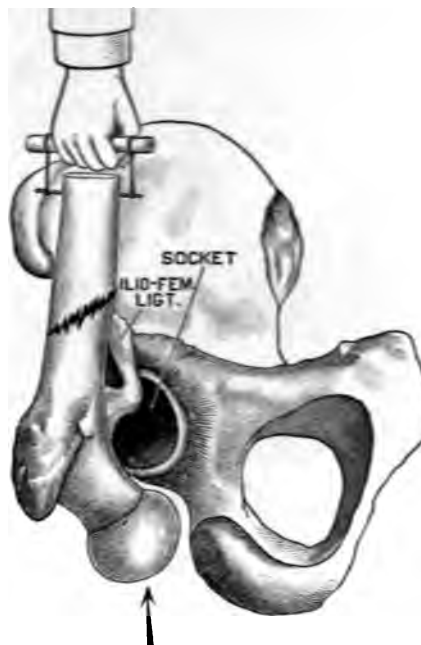
upper fragment. Rotation, circumduction, and leverage through the agency of the lower fragment are impossible. Forward dislocations accompanied by fracture are reduced by traction outward, with pressure upon the head of the bone by the hand of an assistant (Fig. 202). Should this be unsuccessful the head of the bone must be held in position beneath the socket to which it has been drawn, while the surgeon reverses the direction of traction and makes it inward or obliquely inward and downward.

The principle is the same in posterior dislocations, the traction being directly upward, and followed by traction upward and inward,

and accompanied at the same time by pressure of the hand of an assistant upon the trochanter to keep the upper end of the bone from slipping backward (Figs. 230 and 234).

It is possible for the sciatic nerve to be caught over the neck of the femur in practising circumduction to effect replacement. If attempts to release it by reposition and manipulation fail, the suggestion has been made to cut down upon it and liberate it.

FIG. 233.



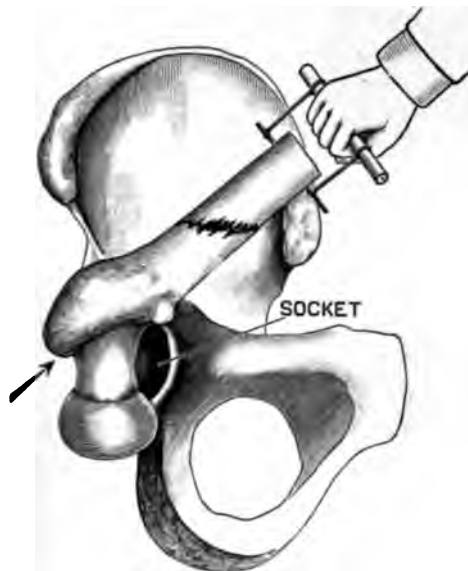
showing first stage of Allis's method of reducing posterior dislocations of the femur complicated with fracture. The arrow represents the direction of the pressure made by the ant. (Allis.)

**Compound Dislocations of the Femur.**—These are rare accidents, and are usually produced by great violence. In such a case attempt should be made to reduce the displaced bone, and if this cannot be successfully done the head of the bone should be excised. Injury of the femoral vessels is not common in dislocation of the femur, but has occasionally occurred in pubic dislocations.

**Old Dislocations of the Femur.**—The reduction of old dislocations of the femur is usually a matter of the greatest difficulty. After the head of the bone has been dislocated for a few weeks it is often impossible to replace it, and this is more likely to be the case in an old ischiatic or obturator dislocation than in a pubic or an iliac dislocation. In old dislocations of the femur the head of the bone

changes, or the acetabulum may become more shallow or from the absorption of the edges, so that it will be difficult to get the bone to remain in place in case of its reduction. For several months attempts to reduce dislocations of the

FIG. 204.



1st stage of Allis's method of reducing posterior dislocations of the femur. The arrow represents the direction of the pressure made by the

ally unsuccessful, but cases of months' or even years' have been reduced. The reduction of old dislocations of the femur should be attempted if the displacement causes great dis-

ART.—The patient should be anesthetized, and the adhesion as far as possible by manipulation of the thigh; then manipulations for the reduction of particular dislocations are tried. If these fail, extension and counter-extension may be effected by the use of the pulley and extending bands, or of angular extension suggested by Bigelow may be tried. It has succeeded in reducing a dorsal dislocation of the femur in several weeks' standing by the use of this method. Where reduction cannot be accomplished, excision of the head of the bone may be resorted to with good results and should be considered in all cases. Should fracture occur near the head of the bone during the reduction of an old dislocation, further manipulation should be abandoned, and the limb dressed in such a position



as to diminish the deformity, with the chance that a false joint might occur at the seat of fracture, thus giving the patient a more useful limb.

**Dislocations of the Patella.**—These occur from blows or falls upon the side of the bone, especially when the knee is slightly flexed or may result from muscular violence. The patella may be dislocated outward, inward, vertically, upward or downward.

**OUTWARD DISLOCATION OF THE PATELLA.**—The outward, external, dislocation of the patella is the most common, because the bone lies in the tendon of the quadriceps extensor cruris muscle, and the tendo-patellæ is attached at an angle, the vertex of which is directed toward the internal condyle. Forceful contraction of

FIG. 205.



Complete dislocation of the patella outward. (Anger.)

FIG. 206.



Dislocation of the patella outward. (Duplay.)

the quadriceps muscle has a tendency to convert the angle into a straight line, and the patella is thrown outward (Fig. 205). The bone may also be displaced by direct violence.

**Symptoms.**—There is an increase in the breadth of the knee, the internal condyle becomes unusually prominent, the limb is abnormally flexed, and the joint is fixed (Fig. 206).

**Treatment.**—Reduction is effected by placing the patient on his back and relaxing the quadriceps extensor cruris muscle by elevating the leg, when the patella can usually be pressed back into place with the fingers. The after-treatment consists in the application of an anterior padded splint or a plaster-of-Paris bandage to fix the knee joint. This dressing should be worn for two or three weeks.

**INWARD DISLOCATION OF THE PATELLA.**—This dislocation is an extremely rare one.

*Symptoms.*—The knee is slightly flexed, and the patella is found resting against the articular surface of the internal condyle.

*Treatment.*—This dislocation is reduced by the same manipulation as that for the reduction of external dislocation of the patella, except that the patella is pressed outward: the after-treatment of the case is similar.

**VERTICAL DISLOCATION OF THE PATELLA.**—Here the patella rests upon its edge in the groove between the condyles, or there may even be a semi-revolution of the bone on its axis, so that the posterior surface of the bone is directed forward.

*Symptoms.*—The leg is extended, and the edge of the patella can be recognized under the skin in front of the knee. The extensor muscles are in a state of tension.

*Treatment.*—Reduction is accomplished, after anæsthetizing the patient, by flexing the thigh upon the abdomen to relax the quadriceps extensor muscle, and while the limb is held in this position an assistant alternately flexes and extends the leg, while the surgeon manipulates the bone with his fingers until it slips into place. The after-treatment consists in fixation of the knee-joint for a few weeks by the application of a posterior splint, or by the use of a plaster-of-Paris bandage.

**UPWARD AND DOWNWARD DISLOCATIONS OF THE PATELLA.**—These dislocations can result only from elongation or rupture of the ligamentum patellæ in the case of the upward dislocation, or the tendon of the quadriceps extensor in the downward dislocation.

*Symptoms.*—The symptoms of either of these dislocations are similar to those of fracture of the patella.

*Treatment.*—This consists either in the use of a posterior splint and adhesive straps to draw the fragments into position, the dressing being very similar to that employed in fractures of the patella; or in operation. The latter is the more satisfactory treatment, and consists in cutting down upon the ruptured tendon and approximating the divided ends with silk or kangaroo-tendon sutures; or, if it has been torn loose from the bone, to drill the bone and pass silk, silver wire or kangaroo tendon sutures through the drill-holes, and secure them to the separated end of the tendon.

**CONGENITAL DISPLACEMENTS OF THE PATELLA** have been observed in a few cases. The treatment consists in the application of a brace. In cases of displacement of the patella from pathological causes, such as relaxation of the ligaments, the *treatment* consists in the use of a compress and a bandage, or the application of a brace,

which limits the motion of the knee and at the same displacement of the patella.

**Dislocations of the Knee.**—Dislocations of the knee are frequent injuries, and result only from the application of violence. The ligaments are very strong, and occupy the internal and posterior aspects of the joint, while in front the patella gives additional strength to the articulation. Dislocation of the knee-joint may be backward, forward, lateral, or rotational.

**FORWARD DISLOCATION OF THE KNEE.**—This may be complete or incomplete, and results from over-extension of the joint by direct violence received upon the front of the thigh or the leg.

*Symptoms.*—In this dislocation, if complete, the leg is displaced from one to three inches, and may be extended or flexed. Two prominences are observed, one in front of the knee, and the other behind the head of the tibia, and the other behind the knee, posteriorly the lower extremity of the femur (Fig. 207). The patella is displaced in front of the tibia or in the depression above the latter.

*Treatment.*—General anæsthesia is necessary. The patient is placed upon his back and extension is made from the knee by extension from the thigh, and, the surgeon's arm being fixed to the joint, the leg is gradually flexed. Under this manipulation the bones usually slip into place. The after-treatment consists of the joint by the application of a posterior padded splint. The front of the joint should also be covered for a few days with lead-water and laudanum. As soon as the swelling subsides the knee-joint should be fixed in the extended position by the application of a plaster-of-Paris bandage, which should be retained for three weeks, after which the patient should be allowed to move the limb, but the joint-motions should be restricted for some time by some form of splint or brace.

**BACKWARD DISLOCATION OF THE KNEE.**—This may be complete or incomplete, and is generally due to violence received upon the front of the leg or the back of the thigh. The patella is usually dislocated outward at the same time, and the leg



**LATERAL DISLOCATIONS OF THE KNEE.**—Lateral displacement may be either external or internal and is generally incomplete. In

FIG. 207.



Subluxation of the head of the tibia forward.

FIG. 208.



Complete dislocation of the head of the tibia backward.

internal lateral dislocation the head of the tibia is carried inward, so that the internal condyle of the femur rests upon the outside of the internal articular surface of the head of the tibia (Fig. 209). In external lateral dislocation the tibia is carried externally, and the

FIG. 209.



Subluxation of the head of the tibia inward.

FIG. 210.



Subluxation of the head of the tibia outward.

external condyle of the femur rests upon the inner portion of the outer articular surface of the head of the tibia (Fig. 210). In either



of these dislocations the patella is displaced, and there is a laceration of the lateral ligaments as well as of the crucial ligaments.

*Symptoms.*—When the displacement is internal, the knee-joint presents a marked increase in its transverse diameter, and the internal tuberosity of the tibia can be felt upon the inner aspect of the joint; upon the outer side a prominence can be detected, which is the external condyle of the femur. In external dislocations two prominences can also be felt, composed of the internal condyle of the femur and the outer side of the external tuberosity of the tibia.

*Treatment.*—Reduction is usually accomplished without difficulty, by making extension and counter-extension combined with pressure upon the displaced bones to force them back into their normal position. The after-treatment of lateral dislocations is similar to that of other dislocations of the knee.

**ROTATORY DISLOCATION OF THE KNEE.**—This is a rare displacement, in which the head of the tibia is twisted either inward or outward. In the external variety the leg is rotated on its axis, so that the internal angle of the tibia is directed forward and externally, the fibula is directed backward, a marked prominence of the patella is seen externally, and the internal condyle of the femur is also prominent, while the inner border of the calf of the leg presents anteriorly.

*Treatment.*—Reduction is accomplished by making extension and counter-extension, and at the same time twisting the leg either in an external or internal direction, opposite to that in which the displacement has occurred.

**COMPOUND DISLOCATIONS OF THE KNEE.**—Compound dislocations of the knee-joint are produced only by great violence, and are often accompanied by laceration of important vessels and nerves in the popliteal space. In cases of compound dislocation of the knee-joint accompanied by extensive destruction of the soft tissues, laceration of the popliteal bloodvessels primary amputation is usually required. If, however, the injury to the soft parts is not extensive and the vessels have escaped injury, an attempt should be made to save the limb. The wound should be thoroughly sterilized, the dislocation reduced, drainage introduced, and the wound closed, a copious antiseptic dressing being applied, and the knee dressed in the extended position, and fixed in this position by the application of splints or plaster-of-Paris bandage.

*Compound dislocations of the knee, complicated with comminution of the head of the tibia or the condyles of the femur, the vessel being uninjured, are cases in which primary excision of the joint, either partial or complete, may be employed with advantage.*

**CONGENITAL DISLOCATIONS OF THE KNEE.**—Congenital dislocations of one or both knees have occasionally been observed. Th

reduction of the dislocation in these cases is soon followed by its reappearance. The most satisfactory method of treatment consists in the application of a brace which limits the motion of the joint, and is provided with pads which prevent the bones from slipping out of place.

**DISPLACEMENT OF THE SEMILUNAR CARTILAGES OF THE KNEE.**—This condition, which is sometimes described as a *subluxation of the knee*, results from a semilunar cartilage becoming loosened from its capsular attachment, and moving in between the tibia and the femur and becoming wedged between the articular surfaces. This may occur in a healthy joint, or in one in which synovitis or osteo-arthritis exists. The cartilage may be entirely detached from the tibia, and may become wedged between the articular ends of the bones, causing locking of the joint. A patient who has once suffered from displacement of a semilunar cartilage is likely to have a recurrence of the displacement.

*Symptoms.*—When this accident occurs the leg becomes suddenly partially flexed and the knee-joint locked; the patient complains of severe pain in the knee, and is unable to bear his weight upon it; at the same time he may suffer from nausea and vomiting. Some swelling of the joint may follow the accident, but quickly subsides after the cartilage is replaced.

*Treatment.*—The replacement of the cartilage can usually be accomplished by flexing and extending the knee-joint, at the same time making rotation. As the muscles hold the knee very rigidly and the manipulations are painful, it may be necessary to give an anæsthetic. Patients who frequently suffer from this accident soon learn to replace the cartilage themselves, by suddenly bearing their weight upon the flexed knee and suddenly transferring the weight to the other leg and extending the knee of the injured leg. After replacement of the cartilage the knee-joint should be fixed by the application of a posterior splint or a plaster-of-Paris bandage for a considerable time. Marsh's clamp, which consists of a steel band extending behind the joint and ending in two lateral plates which clasp the joint and skirt the edges of the patella (Fig. 211), limits the movements of the joint and tends to prevent recurrence of the displacement. If it is found impossible to replace the detached cartilage or if the frequency of the

FIG. 211.



Clamp to prevent displacement of a semilunar cartilage. (Stimson.)

accident causes constant disability, operative treatment should be instituted. Under aseptic precautions the joint should be opened and the displaced cartilage exposed and removed or sutured against the edge of the tibia with silk or silver wire sutures, the wound and the capsule of the joint being subsequently closed with sutures as well as the external wound. After the wound has been dressed a posterior splint should be applied to the leg and thigh to fix the joint, or a plaster-of-Paris dressing applied. Fixation of the joint should be maintained for a few weeks. The results of operative treatment have been very satisfactory both in relieving the condition and in preventing its recurrence.

**Dislocations of the Fibula.**—The fibula may be displaced from the tibia at its upper or at its lower extremity.

**DISLOCATION OF THE HEAD OF THE FIBULA.**—The upper end of the fibula may be dislocated forward or backward. The anterior and posterior tibio-fibular ligaments are torn. The *symptoms* are inability to bear any weight upon the limb, and mobility of the head of the fibula.

*Treatment.*—Reduction is accomplished by flexing the leg at the thigh, to relax the biceps muscles, when the head of the fibula can usually be pressed into its normal position. The limb should then be fixed upon a moulded binders' board splint, with a compress over the head of the fibula, or a plaster-of-Paris dressing should be applied.

**DISLOCATION OF THE LOWER EXTREMITY OF THE FIBULA.**—A few cases of this dislocation have been recorded, in which the lower end of the fibula has been torn from its attachments to the tibia and the foot, and has been displaced backward.

*Treatment.*—Reduction is accomplished by making extension and manipulation at the same time, and after the bone has been returned to its proper place the foot and leg should be fixed with a moulded binders' board splint or by the application of a plaster-of-Paris bandage.

**Dislocations of the Ankle.**—Dislocation of the ankle is usually accompanied by fracture of the malleoli is an uncommon accident. Dislocation of the ankle may be either forward, backward, or lateral.

**FORWARD DISLOCATION OF THE ANKLE.**—This may result from the application of force to the front of the leg when the foot is plantar flexed, or from falls on the heel when the tarsus is flexed, and is likely to be accompanied by a fracture of one or both malleoli. The lateral ligaments are ruptured, the astragalus escapes from the cavity between the tibia and the fibula, and the articular surface of the tibia rests upon the upper surface of the calcaneum. The



*toes* of this dislocation are lengthening of the foot and shortening of the heel; the malleoli may be felt to be lower down than usual, and the tendo-Achillis is less prominent than normally and rests against the tibia.

*Treatment.*—Reduction is accomplished by flexing the leg upon the thigh, in order to relax the gastrocnemius and soleus muscles, and making extension from the foot, with counter-extension from the knee; the bones of the leg should be drawn forward by an assistant at the same time that the foot is forced backward. It is usually necessary to administer an anæsthetic, and in difficult cases the reduction may be facilitated by subcutaneous division of the tendo-Achillis. After reduction the leg and foot should be fixed by the application of moulded binders' board splints or by the use of a fracture-box, and as soon as the swelling has diminished a plaster-of-Paris bandage should be applied.

**BACKWARD DISLOCATION OF THE ANKLE.**—This displacement is caused by the foot being driven backward while in the extended position. The lateral and anterior ligaments are ruptured, and the bones of the leg occupy a position in front of the astragalus (Fig. 212). The tibia may rest in contact with the scaphoid bone, or upon the neck or the head of the astragalus. Here, as in the case of the forward variety, fracture of the external or internal malleolus may be associated with the injury.

*Symptoms.*—The symptoms are shortening of the foot and lengthening and elevation of the heel; the tendo-Achillis stands out prominently upon the posterior portion of the leg.

*Treatment.*—Reduction is accomplished by flexing the leg upon the thigh and making extension and counter-extension from the foot and leg; at the same time the surgeon forces the bones of the leg backward and draws the foot forward. In cases in which much difficulty is experienced subcutaneous division of the tendo-Achillis greatly facilitates the reduction and overcomes the subsequent tendency to displacement. The after-treatment is similar to that employed in forward displacement.

**OUTWARD DISLOCATION OF THE ANKLE.**—This dislocation is produced by force which drives the foot into a state of extreme abduction, and is usually associated with rupture of the internal lateral ligament and fracture of the external malleolus (Fig. 213).

FIG. 212.



Dislocation of the ankle backward. (Bryant.)



*Symptoms.*—These are marked eversion of the foot, prominence of the internal malleolus, and a depression over the lower portion of the fibula, which marks the site of the fracture of that bone.

*Treatment.*—Reduction is accomplished by making extension and counter-extension, combined with adduction of the foot. After reduction lateral moulded binders' board splints should be fitted to the leg, with one compress applied between the external splint and

FIG. 213.



Dislocation of the ankle-joint outward.

the outer portion of the foot, and a second between the internal splint and the leg just above the internal malleolus, the splints being held in position by the turns of a roller bandage. A fracture-box with compresses in corresponding positions may also be employed, the treatment being the same as that for Pott's fracture. In a few days after the swelling has subsided, the foot and leg should be dressed with a plaster-of-Paris dressing, the foot being held in an inverted position until the plaster has become firm.

**DISLOCATION OF THE ANKLE.**—This dislocation is much rarer than outward dislocation, but may result from falls upon the outer border of the foot, or from excessive adduction or inversion of the

FIG. 214.

foot.—The foot is very much inverted, the internal malleolus is prominent and lies beneath the skin (Fig. 214).

*Reduction.*—Reduction is accomplished by extension upon the foot and counter-extension upon the leg, and by manipulation, bringing the foot outward into its normal position. Treatment consists in fixing the foot in its inverted position by the use of binders or the plaster-of-Paris bandage.



Dislocation of the ankle inward. (Bryant.)

**COMPOUND DISLOCATIONS OF THE ANKLE.**—These are the most serious compound dislocations met with, and the results following the various methods of treatment were so unsatisfactory, as regarded the preservation of the limb from septic infection and the loss of function in the majority of cases were subjected to primary amputation. At present more conservative methods of treatment are yielding the most gratifying results. In compound dislocations of the ankle-joint the foot is usually everted, and the articular surface of the tibia is driven through a wound in the soft parts, usually the compound dislocation may consist in an inward displacement of the foot, with protrusion of the astragalus through the outer aspect of the ankle, and fracture of the external malleolus. Compound dislocations of the ankle-joint, particularly when the tibia or the astragalus escapes from a wound at the outer aspect of the joint, are often associated with a rupture of the posterior tibial artery or nerve.

*Treatment.*—In the treatment of this injury the greatest care should be taken to render the wound and the surrounding parts aseptic. The wound should be sterilized in the usual manner and the wound washed with a 1:2000 bichloride solution. If the posterior tibial artery is injured, it should be secured by ligatures; loose fragments are then removed, and free drainage secured by passing a drainage-tube through the wound and bringing it out through a counter-opening upon the opposite side of the joint. Having secured the displacement, the foot should be brought into its natural position, that is, at a right angle to the leg. Where the lower end of the tibia projects from the wound it is often difficult to reduce the dislocation, and resection of the tibia or excision of the astragalus may be necessary before this can be accomplished. The ultimate

result as regards function is good in these cases. If the case is complicated by a fracture of the lower portion of the tibia, it is better to excise a portion of the bone before attempting reduction, as this facilitates the reduction and at the same time relieves tension and favors free drainage. I have seen the most satisfactory results in these cases follow partial excision. If the wound is an extensive one, a few sutures may be introduced at each extremity of the wound; but as the greatest safety is in free drainage, it is wise to allow the wound practically to remain an open one. If the difficulty in reducing the deformity seems to be due to muscular spasm, or if there is a tendency to redisplacement after reduction, by the muscles acting through the tendo-Achillis, this tendon may be divided subcutaneously. After applying a gauze dressing, lateral splints of binders' board, moulded to the foot and leg, holding the foot at a right angle to the leg, should be applied, the foot and leg being placed in a fracture-box. An equally satisfactory dressing consists in the application of a plaster-of-Paris bandage including the foot and leg, and extending a little distance above the knee. At the end of three or four days the splints should be removed, or the plaster-of-Paris bandage should be fenestrated and the wound inspected, and if it has remained aseptic the drainage-tube may be removed and the dressing reapplied. If suppuration occurs in spite of the precautions taken, the drainage-tube should be allowed to remain in place for some time, and irrigation and more frequent dressings of the wound will be required. In cases in which the wound runs an aseptic course and healing takes place promptly, very good functional results may be expected. Where, however, suppuration occurs, the time of repair is very much prolonged, and more or less ankylosis of the ankle-joint follows, which may be permanent.

**Dislocation of the Astragalus.**—The astragalus may be dislocated forward, backward, or laterally, or rotated on its axis.

**FORWARD DISLOCATION OF THE ASTRAGALUS.**—This may be complete or incomplete, and usually results from a fall from a height upon the foot. There is an irregular-shaped prominence in front of the ankle, the foot is usually inverted, and the external malleolus is more prominent than usual.

*Treatment.*—In reducing this dislocation the leg should be flexed upon the thigh, to relax the gastrocnemius and soleus muscles, extension and counter-extension should be made from the foot and leg, and the surgeon should endeavor by manipulation to press the astragalus back into its normal position; if this cannot be accomplished, it may be necessary to divide the tendo-Achillis, which will often facilitate the reduction of the displaced bone. If reduction cannot be accomplished by these means, the displaced bone should be exposed by



and excised. After the reduction or excision of the bone a pasteboard splint should be applied for a few days, and when swelling has subsided a plaster-of-Paris bandage should be applied.

**BACKWARD DISLOCATION OF THE ASTRAGALUS.**—In this accident the astragalus is driven backward from its position between the tibia and the calcaneus, and separated from the os calcis and the scaphoid. This displacement is produced by force acting upon the anterior part of the foot when the tarsus is strongly flexed upon the bones of the leg. There is a swelling above the heel, undue prominence of the Achilles over the displaced bone, and the foot is shortened.

*Treatment.*—Attempts to reduce this dislocation have often proved successful, and the cases have recovered with a fairly useful limb, the bone still out of place. Efforts should, however, always be made to accomplish reduction. The patient being anesthetized, the leg being flexed upon the thigh, extension and counter-extension should be made, and by pushing the bones of the leg backward and moving the foot forward the dislocation may sometimes be reduced. If these manipulations fail, the displaced bone should be

**ATERAL DISLOCATIONS OF THE ASTRAGALUS.**—Lateral dislocations of the astragalus are frequently associated with fracture of either the external or the internal malleolus (Fig. 215). In these dislocations the foot may be inverted or everted.

FIG. 215.



Dislocation of astragalus outward.  
(Hamilton.)

*Treatment.*—They are reduced by the same procedures that are employed in the backward and forward dislocations, and the after-treatment is similar.

**DISLOCATION OF THE ASTRAGALUS BY ROTATION.**—This is a rare form of dislocation of the astragalus. It is produced by the patient falling from a height upon the foot, the foot rotating while the leg is fixed. The astragalus occupies its position between the malleoli, but the relations of its articular surface are changed, the bone being turned vertically or transversely. There is fixation of the ankle-joint with more or less change in shape, produced by the rotation of the astragalus.

*Treatment.*—Attempts should be made to reduce this displacement by making extension and counter-extension, if necessary dividing the tendons subcutaneously and then attempting to replace the bone by



manipulation. This often proves impossible, and excision of the astragalus may be required.

**SUBASTRAGALOID DISLOCATION.**—This is extremely rare and consists in a separation of the calcaneum and the scaphoid from the astragalus. The displacement of the bones may be backward, outward, or inward. Fractures of the astragalus and external malleolus have been observed in connection with it.

**Symptoms.**—The foot is inverted or everted, according as the displacement is outward or inward, and the astragalus can be felt as a prominence in front of the ankle. Shortening or lengthening of the foot would be observed, the first in backward, the second in lateral dislocation.

**Treatment.**—The patient should be anaesthetized, and by traction and counter-extension combined with manipulation it is possible to reduce the deformity.

**COMPOUND DISLOCATION OF THE ASTRAGALUS.**—Compound dislocations of the astragalus are serious injuries, and usually result from falls from a height, the weight of the body striking upon the foot. The astragalus may be completely driven from between the malleoli, or may be only partially displaced.

**Treatment.**—In these dislocations the most satisfactory method of treatment consists in enlarging the wound and excising the displaced bone at once. After the removal of the bone the foot should be placed at a right angle to the bones of the leg, a copious gauze dressing should be applied, and the ankle fixed for a few weeks by the application of a binders' board splint or a plaster-of-Paris dressing.

**Dislocation of the Os Calcis.**—This bone is very rarely dislocated, but may be separated from the astragalus above and from the cuboid bone in front.

**SYMPTOMS.**—The symptoms are distortion of the heel and inability to abduct or adduct the foot. This dislocation usually results from falls upon the heel, or from force applied to the bone at the point of its attachment to the foot.

**TREATMENT.**—The displacement is not difficult of recognition, and should be treated by first anaesthetizing the patient and then reducing the muscles and reducing the displacement by manipulation.

**Dislocation of the Scaphoid.**—This dislocation is also extremely rare. It can be recognized by the projection of the bone on the anterior surface of the foot.

**TREATMENT.**—It is reduced by manipulation, by making traction upon the metatarsus, combined with direct pressure of the bone into its normal position. After reducing the displacement it should be fixed with a binders' board splint or with a plaster-of-Paris dressing.

**Dislocation of the Cuboid.**—The cuboid bone has been dislocated in connection with displacement of other bones of the tarsus, but no cases of independent luxation of this bone have been recorded. From the position of the bone, if this dislocation occurred there would be little difficulty in recognizing the nature of the injury.

**Dislocation of the Cuneiform Bones.**—The cuneiform bones may be dislocated separately, or the three bones may be dislocated together. The internal cuneiform bone is the one most liable to dislocation. There is a prominence on the inner border of the foot, consisting of one or more of the bones. The dislocation is reduced by carrying the metatarsal bones outward when the ankle is fixed, so as to increase the space between the scaphoid and the metatarsal bone of the great toe. After this is done the displaced bones should be pressed into place, and the foot and ankle fixed by the application of a moulded splint or a plaster-of-Paris bandage.

**Dislocations of the Metatarsal Bones.**—Dislocations of the metatarsal bones are not common, but are occasionally seen. The direction of the dislocation may be upward, downward, or lateral. They may result from falls or from the foot being caught and twisted between heavy weights.

**SYMPTOMS.**—The symptoms in these dislocations are a prominence upon either the dorsal or the palmar aspect of the foot, and shortening of the toes corresponding to the displaced bones.

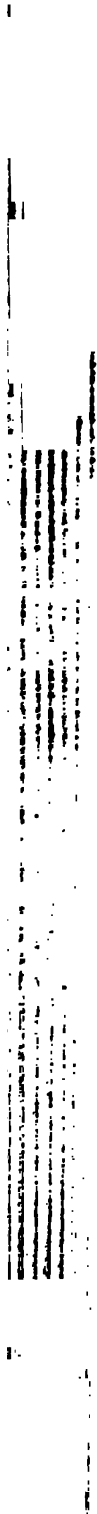
**TREATMENT.**—Reduction is effected by making traction upon the displaced bone from the toe and at the same time pressure over the displaced end of the bone. After reduction a compress should be applied over the seat of the displacement, and the foot fixed by a splint or a plaster-of-Paris bandage.

**Dislocations of the Phalanges of the Toes.**—These dislocations are not so common as dislocations of the phalanges of the fingers, but are occasionally seen, and result from twists and extreme flexion.

**SYMPTOMS.**—The symptoms of dislocations of the phalanges of the toes are a prominence at the articulation and shortening of the injured toe.

**TREATMENT.**—The reduction of dislocation of the phalanges of the toes is accomplished by extension and counter-extension with manipulation. After the reduction the part should be fixed by the application of a moulded binders' board gutter, which should be retained for several weeks.

**Dislocations of the Vertebrae** are considered under Fractures of the Vertebrae.



## MINOR SURGERY AND BANDAGING.

By GEORGE W. SPENCER, M. D.

### BANDAGING.

BANDAGES are made of gauze, flannel, cotton, linen, India rubber, and unbleached muslin. They vary in width and length. According to Wharton and Curtis, bandages for the hands, fingers, and toes should be one inch wide and three yards long; for the extremities in children, two inches wide and six yards long; for the extremities in adults, two and a half inches wide and seven yards long; head-bandages, two inches wide and six yards long; thigh and groin bandages, three inches wide and nine yards long; trunk-bandages, four inches wide and ten yards long.

FIG. 216.



Rolling a bandage by hand. (Wharton.)

For ordinary purposes the best material for bandages is unbleached muslin, which is first washed in sodium carbonate solution to remove the sizing, and is then torn into strips of the desired width and length. The selvage is removed and the strip is made into a roll. In order to roll a strip by hand, one end is folded to the extent of six inches; this is folded upon itself again and again until a firm centre is formed, and over this centre the bandage is rolled. This constitutes a roller-bandage. The method of holding a bandage in order to roll it is similar to that employed by saleswomen to roll ribbon (Fig. 216).



When many bandages are to be rolled, a machine may be used (Fig. 217).

FIG. 217.



Bandage-winder. (Wharton.)

The indications for the use of bandages are to give support, retain dressings or splints, to correct deformities, and to make compression.

When the bandage is employed for the purpose of retaining dressings, the application may be begun at any part of the limb; the bandage is then carried to the point where the dressings are to be covered. After such a bandage has been applied, if the patient complains of too much constriction, the first turns should be cut with scissors.

If a bandage is to be used to make pressure on any portion of a limb, its application should be begun at the fingers or toes, and the bandage should be carried up to the place where the pressure is needed. Compression should not be made in the middle of a limb by a tightly applied bandage without having first included the fingers or toes, as such a procedure would produce pain, swelling, and œdema, and, if prolonged, might cause gangrene.

**For Retaining Dressings.**—The wet gauze bandage is generally in favor, because it answers the purposes of the ordinary muslin bandage, can be applied with great neatness, and can easily be rendered antiseptic. This bandage is made of cheesecloth, which is first boiled in a solution of sodium carbonate, and then rinsed in clean water and dried; it is then cut into strips and rolled into bandages. The gauze bandage may be applied while dry or it may be kept in a 1:2000 solution of corrosive sublimate, which renders it antiseptic, until ready for use, and then be used directly from this solution. When such a bandage is to be applied, it is first squeezed, and must then be put on more loosely than a dry one, as it contracts on drying and may become too tight.

If one is not expert in bandaging and wishes to make a neat dressing, he should use the wet gauze bandage, as it readily adjusts itself to the inequalities of a surface (Fig. 218). Its chief advantages are its lightness, coolness, thinness, and softness.

FIG. 218.



The wet gauze bandage.

Bandages to give Support and make Compression.—If we are dealing with a condition which is in need of support and compression, such as a slight sprain, a swollen joint, varicose veins of the leg, or eczematous ulcers of the lower extremities, bandages made of some elastic material should be used, such as flannel, elastic webbing, or India rubber. There are two forms of India-rubber bandage which have special names: one, which is very thin, and made of rubber similar to that employed in making rubber dam, is known as Martin's bandage (Fig. 219); the other, which is thick and heavy, is known as Esmarch's bandage. Martin's bandage is used in the

FIG. 219.

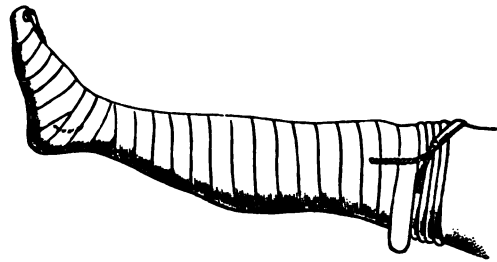


Martin's rubber bandage. (Wharton.)

**palliative treatment of varicose veins of the leg.** Its application may cure an ulcer of the leg caused by varicose veins. This bandage when applied will give an elastic support which will have a tendency to turn the flow of venous blood from the superficial veins in deep veins. In this condition the Martin bandage should be applied while the leg is slightly elevated and before the patient arises in the morning; it should not be removed until he has retired at night. After it has been removed it should be washed with soap and water, dried, and hung up until morning.

The Esmarch bandage (Fig. 220) is used to force blood out of the extremity previous to an amputation, and occasionally to treat an aneurism, but is unsuitable, because of its weight and thickness, for the treatment of varicose conditions. The flannel bandage is

FIG. 220.



Esmarch's bandage and tube applied. (Wharton.)

used to protect a part before plaster-of-Paris is applied, and is also of use to envelop rheumatic and gouty joints, as it prevents the escape of heat and, therefore, lessens pain. When it is desired to give pressure or support, in case of sprain, varicose veins, effusion, etc., the flannel bandage is most useful when cut bias and made of sufficient length, as it is then much more elastic than when cut straight.

**Fixed Dressings.**—By the addition of certain substances, such as plaster-of-Paris, sodium silicaté, starch, glue, gum and chalcid, or celluloid, to a bandage, a fixed or solid dressing may be made. Such bandages are used to secure immobilization of the part in the treatment of fractures, particularly in young and restless children and in patients who are delirious. They are also employed in the treatment of injuries and diseases of joints, in certain deformities, and after operations upon bones. Of the fixed dressings, plaster-of-Paris and sodium silicate are preferred by most physicians.

**PLASTER-OF-PARIS BANDAGE.**—The old method of preparing plaster-of-Paris bandages was by sprinkling or spreading the plaster with one hand and rolling the bandage with the other. It is extensively used, but has the disadvantages of slowness of appli-



and of unevenness in the distribution of the plaster. Probably the simplest and most efficient device is that originated by Dr. J. T. Rugh, which is quickly made as follows: slits about one-sixteenth inch wide and six inches long are cut at the bottom edges of opposite sides of a small box (preferably one with a removable bottom); one end of a gauze bandage is passed in through one slit and out through the other; the box is now filled with dry plaster and the bandage rolled as it is drawn through (Fig. 221). If there is insufficient plaster on

FIG. 221.



Dr. Rugh's "cigar-box" plaster-bandage roller.

the gauze, the slits should be made wider. When a plaster bandage is to be used, it is immersed endwise into a basin of warm water. If it is desired to have the bandage set rapidly, salt should be added in the proportion of a half-cup to a gallon of water; if slowly, a glass of stale beer should be poured into the water or cold water used without salt.

When air-bubbles cease to rise from the water, the bandage should be slightly squeezed, to free it from excess of water, and applied without much tension. Every turn of the bandage should be thoroughly rubbed while being applied, to render the mass homogeneous (Fig. 222); and if more than one bandage is to be used, a second one should be placed in the water as soon as the first is removed. After twenty-four hours the bandage may be varnished; this will prevent chipping and absorption of discharges or exudates (Bryant).

Before applying a plaster-of-Paris bandage the extremity upon which it is to be placed should be covered with a lint or flannel bandage.

To remove a plaster bandage, saw down the front, or moisten with water and cut with a strong knife. Gigli has devised an ingenious and useful method for removing a plaster cast. He puts flannel and cotton around the limb and a layer of moist



paraffin-paper over this upon the front of the extremity; a long thick cord which has been greased is placed on the paraffin paper in the direction one would pursue in removing the cast with

FIG. 222.

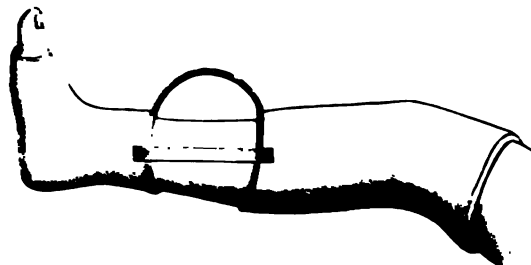


Leg encased in plaster-of-Paris dressing. (Wharton.)

a knife or saw. Over this the plaster bandage is applied. When finished, about four inches of the cord should project above and below the plaster cast. After the bandage has been worn for required time it can easily be removed by tying one of the projecting ends to a fine steel wire which has been converted into a saw by a number of fine notches made transversely throughout its length. Motion is made on the free end of the cord, the wire is drawn taut, and by a to-and-fro movement the cast is sawn through and removed.

An interrupted plaster dressing is made by applying the plaster bandages in such a manner that immobilization of the part is secured, and a certain area is left exposed for the purpose of examination or treatment. The opening is termed by some operators a "trap-door dressing" (Fig. 223). This so-called trap-door can be made

FIG. 223.



Interrupted plaster-of-Paris dressing. (Stimson.)

by placing a bottle or box of the desired shape on the area to be exposed, and applying the plaster around it. After setting occurred the object is removed and the end accomplished; a piece may be cut out of the plaster dressing before it has set hard

ce of tin or iron bent into a large loop may be used to connect parts of the bandage above and below the wound; the ends of bracket are included in the turns of the plaster bandage. In conditions as compound fractures and resections of joints or as two or three of these brackets are necessary.

**SODIUM SILICATE DRESSINGS.**—This is another form of fixed dressing which is much lighter than the plaster-of-Paris. The author has used it with success in treating sprains, and fracture of the clavicle in restless children (Fig. 224). The part should be protected by cotton or flannel, and over this gauze bandages which have been soaked in sodium silicate are applied. Six layers of bandage will

FIG. 224.



Fracture of the clavicle treated with sodium silicate dressing.

be sufficient. Silicate dressings require from twelve to eighteen hours to dry. The dressing can be removed by a cutting instrument after it has been softened with water, but is better removed with a saw.

**Sling.**—A sling is an appliance by means of which the extremity is supported. It can be made by passing a 4-inch muslin roller bandage over the back part of the neck and under the wrist. The bandage is then cut and the two ends are fastened together. The bandage should be long enough to allow the forearm to rest a little below the umbilical line. The triangular sling is very popular, as

it affords support to the hand, forearm, and elbow. This sling can be made from a square piece of muslin; but a large handkerchief folded so as to form a three-cornered piece makes an admirable substitute. This folded handkerchief is passed under the forearm in such a way that the apex projects behind the elbow; the end of the base next to the body is then carried over the shoulder of the sound side, and the other end is carried over the shoulder of the affected side. The ends meet behind the neck and are there tied. The apex is straightened out from behind the elbow and pinned to the anterior portion (Fig. 225).

FIG. 225.



Triangular sling.

**General Rules for Bandaging.**—The bandage is held in such a way as to allow the end to hang free. The outer surface of this end is placed upon the extremity and held there until it is fixed by several circular turns.

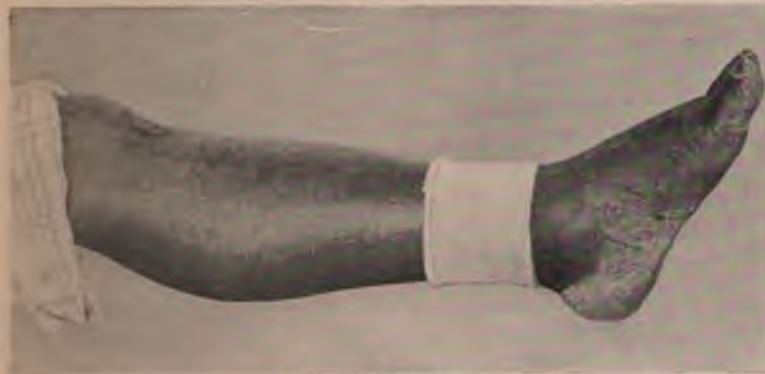
A bandage should be so applied that it will cause equal pressure upon all portions of the extremity covered by it, and the pressure must not be sufficient to cause pain, swelling, or numbness. In bandaging an extremity, the turns near the fingers and toes should be



trifle tighter than the turns near the trunk. A tight bandage should never be applied to the thigh, leg, arm, or forearm for any length of time without including the foot or the hand. In applying fixed dressings, so arrange them that the ends of the fingers or toes can be inspected in order to determine the state of circulation in the part. If from the shape or use of the limb the bandage tends to slip, it can be kept in place by adhesive strips. These should be one inch wide, and long enough to extend several inches above and below the bandage over which they are passed in the long axis of the limb, and the ends stuck to the skin.

**The Names of Bandages; the Indications for Their Use and Their Application.**—Bandages which are named according to their mode of application are circular, recurrent, oblique, spiral, spiral reversed, single, double, ascending or descending spica. Bandages which are named according to their shape and the figure they resemble when applied are gauntlet and demi-gauntlet, the figure-of-eight, the single and compound T-bandage, the four-tailed bandage, the many-tailed bandage, and the V-bandage of the head. Bandages which are

FIG. 226.



The circular bandage.

called after the men who originated the manner in which they are applied are Barton's, Gibson's, Borsch's eye bandage, Velpeau's, Desault's, and Selva's thumb bandage. Mayor, of Geneva, showed that a square piece of cloth can be folded in such a manner that it will in a number of instances answer the purpose of a bandage. This is known as Mayor's handkerchief-dressing.

**THE CIRCULAR BANDAGE.**—This bandage consists of circular turns applied around a part. They neither ascend nor descend, but each turn covers accurately its predecessor. It is employed to keep in place a dressing to a limited portion of the head, neck, wrist, or ankle. Several tight turns of such a bandage are used to render the



vein prominent before the performance of transfusion or venesection (Fig. 226).

The RECURRENT BANDAGE is a very useful bandage, and when well applied makes a neat dressing. It is largely employed to retain dressings to the hand and fingers, as after a burn involving all the fingers. It is the bandage most generally employed to hold dressings on the head after injuries to the cranium and scalp. When this bandage is properly applied to a stump after an amputation, it will retain the dressings and obliterate the dead space between the flaps and end of the stump.

*Recurrent Bandage of the Hand and Fingers.*—The hand

FIG. 227.



Recurrent bandage. (Wharton.)

held in pronation and the initial extremity of the bandage secured by three circular turns around the wrist; the recurrent turns are started on the dorsum of the wrist (Fig. 227); the bandage is reversed and carried down in the long axis of the hand, passed over the tips of the fingers, and carried along the palmar surface of the hand to the under surface of the wrist opposite to where it commenced. This manipulation is continued until the fingers and hand are covered. The bandage is completed by three circular turns around the wrist or a figure-eight of the palm and wrist.

*Recurrent Bandage of a Stump.*—This should be applied with a single roller, two and a half inches in width and seven yards in length, commencing with three circular turns a few inches above the end of the stump; when the third turn reaches the centre of the anterior surface the thumb secures the bandage while it is reversed and carried over the centre of the end of the stump to a point on the posterior surface opposite to where the reverse was started. It is then held on the posterior surface, while the roller is carried over the end to the anterior surface, and these turns repeated until the end is well covered. These recurrent turns are secured by three circular turns around the stump, after which a spiral or spiral reversed bandage should complete the dressing by covering the stump to a point above where the recurrent turns terminated, and should end by three circular turns around the part at this point (Fig. 228).

After this bandage has been applied, if there is a tendency for it to become disarranged, several long strips of adhesive plaster will retain it nicely in place if they be stuck to the skin above the bandage, and

ried over the end of the stump and applied to the skin above the  
dage on the under surface.

FIG. 228.



Recurrent bandage of stump. (Wharton.)

*Recurrent Bandage of Head.*—A roller, two inches wide and six  
ds long, is first passed twice about the forehead and occiput.  
hen the middle of the forehead is  
ched the bandage is reversed and carried  
er the top of the head to the occiput,  
l there secured by an assistant. It is  
in reversed and brought to the fore-  
d, and so on, each turn covering two-  
rds of the preceding one, until the  
ire head is covered; then two circular  
ns are made and the end pinned  
g. 229).

FIG. 229.

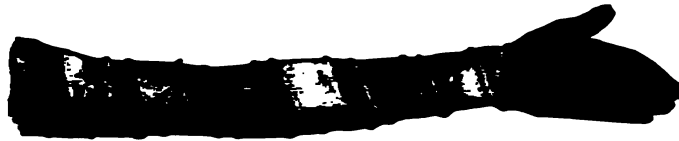
Recurrent bandage of the head.  
(Wharton.)

In a delirious or restless patient, and  
young children, this bandage is liable  
become displaced. In such patients a  
ce of bandage should be pinned to the  
d bandage above and in front of the  
on one side, carried under the chin and  
ned on the opposite side at a corre-  
nding point. Adhesive strips stuck to the skin on one side of  
face below the bandage and passed over the bandage and stuck to  
other side of the face will also hold this bandage in place; and  
a long piece of plaster be stuck to the root of the nose and carried  
r the bandage and fastened to the skin on the nape of the neck, it  
render it much more secure.

*THE OBLIQUE BANDAGE.*—In this form of dressing the bandage  
tarted by several circular turns; it is then carried up the extremity  
blique turns, each turn being made about an inch above the pre-

ending one. When this bandage is finished uncovered spaces can be seen between the turns. Its use is limited in extent, it being chiefly of service in holding in place dressings applied to burns and scalds (Fig. 230).

FIG. 230.



Oblique bandage. Wharton.)

**THE SPIRAL BANDAGE.**—This bandage is employed to give support and retain dressings on a portion of the body which does not vary much in its circumference. In this bandage the turns are carried around the part after the initial extremity of the roller has been secured by several circular turns. As the bandage is applied each turn overlies one-third of the preceding turn.

*Spiral Bandage of the Chest.*—This bandage is useful in retaining dressings to the chest and giving support in cases of contusion of the soft parts on the chest-wall. It may also be used as a temporary dressing in fracture of the ribs or sternum.

To apply a spiral bandage to the chest requires a muslin bandage three inches wide and ten yards long. The bandage is started by three circular turns around the chest over the last ribs; it is then carried upward, each spiral turn overlying one-third of the preceding turn until the level of the lower part of the axilla is reached. The roller is then carried under the axilla to the post-axillary line, passed obliquely upward over the opposite shoulder and down the front of the chest, where it is pinned or sewed to the spiral turns (Fig. 231). The bandage can be strengthened by applying adhesive strips.

*Spiral Bandage of the Finger.*—This bandage is employed to hold dressings in place and to retain a splint after operation, fractures, dislocations. To apply this dressing, a roller bandage one inch wide and one and a half yards long is required. Two circular turns are taken around the wrist; the bandage is then carried obliquely across the dorsum of the hand and around the base of the finger to be bandaged. By spiral turns it is now carried to the tip of the finger, a circular turn is then made, and the finger is covered by ascending spiral turns. The roller is then carried obliquely across the dorsum to the wrist and the dressing is finished by two circular turns around the wrist (Fig. 232). When all of the fingers are covered by this method similar to the above the bandage is known as the "gauntlet."

*Spiral of all the Fingers, or the Gauntlet Bandage.*—



gauntlet bandage is of service in retaining dressings on an injured hand, and is sometimes employed to produce compression in hemorrhage from the palmar arch. To apply it, the initial extremity of a bandage one inch wide and three yards long is secured at the wrist

FIG. 231.



Spiral bandage of the chest. (Wharton.)

FIG. 232.



Spiral bandage of the finger. (Wharton.)

by two or three circular turns. The roller is then carried obliquely across the dorsum to the thumb, and spiral turns are taken around the thumb down to the tip; the spiral turns are then continued up the thumb until the metacarpal phalangeal articulation is reached, then the roller is carried obliquely across the dorsum and a circular turn is taken around the wrist. Each finger is covered in the same manner, and the dressing is completed by two circular turns around the wrist (Fig. 233).

*Demi-gauntlet Bandage.*—This is a spiral bandage of the palm or dorsum of the hand, and has a limited use, being employed to hold light dressings to the dorsal or palmar surface of the hand. It should not be applied tightly, as the pressure at the base of the fingers will cause the fingers to swell and much discomfort may be experienced.

The demi-gauntlet may be applied so as to leave either the palm or dorsum of the hand uncovered. If the palm is to be covered, the hand is held in supination during the application of the bandage; but if the dorsum, the bandage should be applied while the hand is in pronation. To apply the demi-gauntlet, the free extremity of a bandage one inch wide and four yards long is fixed by two circular turns around the wrist; the roller is then carried around the base of the thumb and passed obliquely across the dorsum of the hand to



the starting-point; a circular turn is then taken around the wrist and each finger is treated in the same manner, the dressing being finished by two circular turns around the wrist (Fig. 234).

FIG. 233.



Gauntlet bandage. (Wharton.)

FIG. 234.



Demi-gauntlet bandage. (Wharton.)

*Spiral Reversed Bandage.*—When a portion of the body, of irregular shape and varying greatly in circumference, is to be bandaged, the spiral reversed bandage will take the place of the spiral reversed, as the reverse corrects the inequality which exists in a spiral bandage when applied to such a part. This bandage is a spiral bandage with reversed turns; the bandage ascends. It is extremely useful for retaining dressings and making equal pressure upon the extremities. The reverse is made in the following manner: after the free extremity of the roller has been fixed by two circular turns the bandage is carried up the limb obliquely; the surgeon's left thumb is then placed on the part of the bandage which has been carried obliquely upwards (Fig. 235). The roller, which is in the surgeon's right hand, is unrolled until there are six inches of free bandage between the thumb and the left thumb. The hand holding the bandage is pronated, the bandage carried transversely under the limb; slight traction is made, which brings the reverse into place. All the reverses should be in a line, but should not overlie large bony prominences.

*Spiral Reversed Bandage of the Upper Extremity.*—This bandage is employed to retain dressings on the forearm and arm, and is generally used to hold splints in place in the treatment of fractures and dislocations involving the bones of the forearm and arm. A roller two and a half inches in width and seven yards in length is employed for this bandage. The bandage is applied as follows: the arm and forearm are held away from the body, absorbent

is introduced between the fingers, and the forearm is pronated or supinated according to the indications. The free extremity of the roller is fixed above the wrist by two circular turns; it is then carried across the hand, and opposite the second joint of the fingers a circular turn is made around all the fingers. The hand is then covered by

FIG. 235.



ascending spiral or spiral reversed turns until the thumb is reached; here a few figure-of-eight turns are made around the base of the thumb and the wrist. The bandage is then taken up the forearm by spiral reversed turns, the elbow is covered in by a figure-of-eight, and the arm is covered by a spiral or spiral reversed. The dressing is completed by two circular turns, or, if advisable, by a spica of the shoulder (Fig. 236).

FIG. 236.



Spiral reversed bandage of the upper extremity. (Wharton.)

*Spiral Reversed Bandage of the Lower Extremity.*—This bandage is applied to the lower extremity to secure splints in the treatment of sprains, fractures, and dislocations. It is also employed to hold dressings in place, to make pressure, and to give support. To apply the bandage, the leg should be extended and supported by an assist-



ant. The initial extremity of a roller bandage two and a half inches wide and seven yards long is placed upon the anterior surface of the leg just above the ankle, and two circular turns taken around the leg at this point. The bandage is then passed obliquely over the dorsum of the foot and a circular turn is taken around the foot over the metatarsophalangeal joints; the foot is then bandaged by several spiral reversed turns, and three figure-of-eight turns are applied above

FIG. 237.



Spiral reversed bandage of the lower extremity. (Wharton.)

the ankle and the instep; a circular turn is taken above the malleolus and the bandage is carried up the leg by spiral reversed turns. If the limb is to be kept in the extended position, the knee can be covered by spiral reversed turns; but if it is to be flexed, the figure-of-eight turns should be applied. In either case, after the knee has been covered the spiral reversed turns are continued up the thigh, and the dressing is finished by several circular turns or by a spica of the groin (Fig. 237).

FIG. 238.



Barton's bandage. (Wharton.)

FIG. 239.



Barton's bandage, showing crossing of turns at vertex. (Wharton.)

**BARTON'S BANDAGE.**—This bandage is a figure-of-eight of the jaw and occiput, alternating with circular turns about the chin and

occiput, and is applied as follows: the end of a roller bandage two inches wide and five yards long is held back of the left ear; the roller is then passed around the occiput back of the right ear to the vertex; then in front of the left ear, under the jaw, in front of the right ear, over the vertex to the starting-point; then a circular turn is made around the chin and below the ears, and these turns are repeated until completed. Pins are then placed at the ends and points of crossing (Figs. 238 and 239). This bandage may be modified by making one or two turns about the forehead (figure-of-eight of the forehead and forehead), which will give much greater security to the vertical turns (Fig. 240). The chief indications for this bandage are fractures or dislocations of the jaw and injuries to the chin.

FIG. 240.



Modified Barton's bandage. (Wharton.)

FIG. 241.



Gibson's bandage. (Wharton.)

**GIBSON'S BANDAGE.**—For this, a circular of the vertex and chin, occiput and forehead, and the occiput and chin, a roller bandage two inches wide and six yards long is used. Beginning at the top, the turns of the bandage are made around the jaw and vertex; then above the ear on the third turn, three turns are run about the forehead, and then it is carried to the nape of the neck and three turns are made around the chin and occiput below the ears; finally, the end is carried from the middle of the neck over the occiput and vertex to the centre of the forehead, and there firmly pinned. It is also secured at the points of crossing of the turns (Fig. 241). Its indications are the same as those of Barton's.

**CROSSED OR OBLIQUE BANDAGE OF THE ANGLE OF THE JAW.**  
The end of a bandage two inches wide and six yards long is first



secured by two turns around the head above the ears; the roller is then carried around the occiput, under the ear of the sound side and under the jaw; sufficient turns are now

FIG. 242.



Oblique bandage of the angle of the jaw. (Wharton.)

made around the head, in front of the ear on the injured side and behind the ear of the sound side, to cover in the affected area, each turn over this area slightly overlapping the preceding one. It is completed by being reversed at a point on a level with the ear and passed about the head several times as at first and securely pinned. It is used for fractures at the angle of the jaw and to maintain dressings in place on the head, and is one of the most satisfactory of all head-bandages (Fig. 242).

**BORSCH'S EYE-BANDAGE.**—This very useful dressing is applied as follows:

strip of bandage is first placed over the top of the head, one end hanging over the sound eye and the other over the back of the head; circular turns are then made over both eyes, the end pinned, and

FIG. 243.



FIG. 244.



Application of Borsch's eye-bandage. (Wharton.)

the ends of the strip then lifted and pinned over the head, which leaves the sound eye uncovered (Figs. 243 and 244).

**CROSSED BANDAGE OF BOTH EYES.**—This is a figure-of-eight of both eyes, and is thus applied: a roller two inches wide and six yards long is first passed a couple of times about the forehead; then it is carried downward over the one eye, under the corresponding ear, around the head, above the other ear, across the forehead, to the occiput, then under the ear and upward across the uncovered eye. These turns are repeated until finished and the ends secured by a pin (Fig. 245).

**VELPEAU'S BANDAGE.**—This is applied to the arm and shoulder, with the arm in Velpeau's position, and is chiefly used in fractures of the clavicle. The method is as follows: with the skin and fingers protected by cotton, the hand of the injured side is placed, thumb up, against the shoulder of the sound side. The end of a roller two and one-half inches wide and ten yards long being held back of the

FIG. 245.



Crossed bandage of both eyes. (Wharton.)

FIG. 246.



Velpeau's bandage. (Wharton.)

axilla of the sound side, the roller is passed across the back, over the injured shoulder, down over the arm to the back of the elbow, underneath the forearm, across the chest, and through the axilla to the point of beginning. A circular turn is now made about the arm and chest, and these two repeated alternately until completed. It may be rendered much more secure by the application of adhesive strips (Fig. 246).

**DESAULT'S BANDAGE.**—This bandage is employed in the treatment of fracture of the clavicle. The Desault dressing requires a wedge-shaped pad and three roller bandages; each bandage should be two and a half inches wide and seven yards long. The wedge-shaped pad is placed in the axilla with the base upward, and secured by the first roller of Desault's bandage applied in the following manner: the free extremity of the roller is placed upon the pad and fixed by two or three circular turns around the chest and the pad; the roller is then carried obliquely across the front of the chest to the sound shoulder, then under the axilla, passed over the shoulder and carried around the chest to pass over the pad; the bandage is then carried obliquely downward to the lower portion of the chest, and by spiral turns the bandage is carried up the chest until the base of the pad is covered (Fig. 247). The second roller of the Desault binds the arm to the side over the pad and corrects the inward deformity of a



fractured clavicle. It consists of a number of circular turns around the chest, including the arm. These turns extend from the head

FIG. 247.



First roller of Desault's bandage. (Wharton.)

the humerus to the elbow, and each turn overlaps one-half preceding turn. The upper turns are applied very lightly. As they descend the tension on each turn is increased (Fig. 248). The

FIG. 248.



Second roller of Desault's bandage. (Wharton.)

roller of Desault corrects the downward and forward displacement of the fractured clavicle. The bandage starts in the axilla of the injured side anteriorly, passes to the top of the shoulder of the injured side, down the back of the arm of the injured side to the elbow, and then to the point of origin. The roller is then carried backward obliquely over the back of the chest to the shoulder of the injured side, and ducted down the front of the arm of the injured side to the elbow, and from this point it is carried across the back to the point of origin. These turns are repeated until three sets of turns have been applied. The forearm is then supported in a sling (Fig. 249).

**THE SPICA BANDAGE.**—The spica bandage is practically a

of-eight; each turn overlaps the previous one in such a way as to resemble a spica. If the turns overlap each other from below upward or from above downward, it is known as an ascending or

FIG. 249.



Third roller of Desault's bandage. (Wharton.)

descending spica; and according as the turns cross in front, behind, or at the side, the bandage is named an anterior, posterior, or lateral spica.

The bandage may be applied so as to form a single spica; but when the corresponding joint on the opposite side of the body is at the same time covered in by a spica the dressing is called a double spica. The spica bandage is very serviceable in giving support, in making compression, in retaining splints, and holding in place dressings applied to a part which is irregular in outline, such as the shoulder, hip, thumb, and ankle.

*Spica Bandage of the Thumb.*—For this bandage a roller one inch wide and three yards long is used. The free extremity of the bandage is secured at the wrist by two circular turns; the bandage is then carried to the tip of the thumb by spiral turns; it is then carried obliquely upward over the dorsal surface of the thumb and around the wrist. A series of ascending figure-of-eight turns is now made between the thumb and wrist, each turn overlapping the previous turn two-thirds as it ascends, and each figure-of-eight turn alternating with a circular turn around the wrist. The figure-of-eight turns of the thumb and wrist and the circular of the wrist are repeated until the thumb is covered. The dressing is completed by a circular turn about the wrist (Fig. 250).

*Spica Bandage of the Shoulder.*—To apply this bandage to the right shoulder, the initial extremity of a roller two and a half inches wide and seven yards long is placed upon the lower part of the upper third of the arm, and fixed by two or three circular turns about the arm from within outward. The bandage is then carried over the



injured shoulder across the anterior surface of the chest through the axilla of the sound side. From this point it is passed obliquely upward over the back, brought over the injured shoulder, and passed around the arm at the point where the bandage commenced. Successive and advancing turns should now be made, each turn overlapping the pre-

FIG. 250.



Spica bandage of the thumb. (Wharton.)

FIG. 251.



Spica bandage of the shoulder.

vious turn about two-thirds, until the shoulder is well covered (Fig. 251). When the bandage is carried under the axilla of the sound side each turn should exactly overlies the preceding turn. The bandage should be so applied that the spica turns occupy the median line on the outer side of the shoulder.

A layer of absorbent cotton interposed between the bandage and the skin in the armpits will prevent the bandage excoriating the skin.

Disarrangement of the bandage may be prevented by passing long, narrow strips of adhesive plaster over it, and fastening the ends of the plaster to the skin above and below the bandage.

When this bandage is to be applied to the left shoulder, the free end is secured to the upper arm, the roller is then carried over the injured shoulder, passed obliquely downward through the axilla of the sound side, and then across the chest to the point of starting. Successive and advancing turns are then made.

The spica bandage of the shoulder is sometimes employed to terminate a spiral reversed bandage of the upper extremity; it is also used to correct deformities about the acromial end of the clavicle; it is largely employed to retain the shoulder-cap used in the treatment of fractures about the shoulder, and dressings can be easily kept in place by its use.

*Single Spica Bandage of the Groin.*—Take a roller bandage two and a half inches in width and seven yards in length; start it by two circular turns around the upper part of the thigh; carry the bandage obliquely upward across the lower part of the abdomen and above the anterior superior spine of the ilium of the sound side; then carry the bandage obliquely downward across the back, to below the anterior superior spine of the injured side; bring it over the anterior surface of the groin, then around the inner, under, and outer sides of the thigh to the starting-point. A series of turns is now taken similar to the ones just described, each turn ascending and covering in two-thirds of the previous turn. It will take eight or ten such turns to complete the dressing. Care should be taken to have the bandage each time cross as nearly as possible in the median line (Fig. 252).

FIG. 252.



Descending spica bandage of the groin.  
(Wharton.)

FIG. 253.



Double spica bandage of the groins.  
(Wharton.)

*Double Spica Bandage of the Groins.*—This dressing will require two roller bandages, each two and a half inches in width and nine yards in length. Take the initial end of one of the roller bandages and secure it to the abdomen by three circular turns just above the anterior superior spines of the ilium; then carry the bandage from the crest of the right ilium obliquely downward and forward across the lower part of the abdomen and around the outer surface of the thigh; next pass it under the thigh and upward, between the scrotum and the thigh, then obliquely upward across the previous turn in the median line. Now carry it around the abdomen, down over the front of the groin and up over the front of the left groin around the abdomen. These turns are continued, each turn overlying two-thirds of the previous turn (Fig. 253).



**THE FIGURE-OF-EIGHT BANDAGE.**—The figure-of-eight bandage is employed to retain dressings and give support. It is also largely employed to bandage the neck and the axillæ and the occiput and jaw.

*Figure-of-eight Bandage of the Elbow.*—To apply the figure-of-eight bandage to the elbow, the extremity should be flexed and supported. The free extremity of a roller bandage, two inches wide and four yards long, is fixed to the upper part of the forearm by two circular turns. The bandage is then carried obliquely upward over the anterior surface of the joint to a point a little below the middle of the arm, where a circular turn is made. The bandage is then carried obliquely downward to below the elbow and passed about the forearm by a circular turn. The route being thus laid out, these turns are repeated, the turns from the forearm ascending and those from the arm descending, and each turn crossing the front of the elbow until the elbow is completely covered; the dressing terminates with a circular turn around the elbow-joint (Fig. 254).

FIG. 254.



Figure-of-eight bandage of the elbow. (Wharton.)

*Figure-of-eight Bandage of the Neck and Axilla.*—This bandage is employed to retain dressings to the base of the neck, top of the shoulder, and the axilla. To apply the figure-of-eight to the neck and the axilla, the free extremity of a roller bandage, two inches wide and five yards long, is placed on the side of the neck and retained by

two circular turns taken from left to right around the neck. The bandage is then carried across the root of the neck, over the shoulder to the posterior axillary fold, through the axilla to the anterior axillary fold, and over the front of the shoulder across the base of the neck and back to the starting-point. A series of such turns should be made until the shoulder is covered, each turn overlapping two-thirds of the previous one. The dressing terminates with a circular turn around the neck. If this bandage is to be applied to the neck and left axilla, the bandage is started by two circular turns around the neck taken from right to left. It is then applied similarly to the figure-of-eight for the neck and right axilla (Fig. 255).

FIG. 255.



Figure-of-eight bandage of the neck and axilla. (Wharton.)

*Anterior Figure-of-eight Bandage of the Chest.*—This bandage is employed to retain dressings upon the anterior part of the chest. It is sometimes useful in correcting certain deformities and in the treatment of fractures and dislocations about the acromial end of the clavicle. To apply this bandage, the free extremity of a roller bandage, two and a half inches wide and seven yards in length is placed in the axilla of one side and secured by two circular turns around the chest. The roller is then passed through the axilla and

FIG. 256.



Anterior figure-of-eight bandage of the chest. (Wharton.)

over the shoulder of the same side; it is then carried across the upper part of the sternum to the anterior axillary fold of the opposite side, and from this point through the axilla, over the shoulder, and across the anterior part of the chest to the starting-point. These turns should be repeated, ascending from the shoulder toward the neck, each turn overlapping three-fourths of the previous turn (Fig. 256).

*Posterior Figure-of-eight Bandage of the Chest.*—This bandage is



employed to hold in place dressings applied to the upper part of the back. It is sometimes useful in the treatment of fracture of the clavicle. The application of this bandage requires a roller bandage two and a half inches in width and seven yards in length. The free end of the roller is placed on the top of the shoulder of one side; it is then carried obliquely downward across the back to the axilla

FIG. 257.



Posterior figure-of-eight bandage of the chest. (Wharton.)

of the opposite side; it is then passed through the axilla and carried over the shoulders, obliquely across the back to where it started. These turns are repeated seven or eight times, being directed from shoulder to axilla (Fig. 257).

*Figure-of-eight Bandage of the Knee.*—This bandage is employed to retain dressings to the knee and to give support. When a spiral

FIG. 258.



Figure-of-eight bandage of the knee. (Wharton.)

reversed bandage is being applied to the leg and thigh, and it is advisable to have the patient extend and flex his leg, the knee should be covered with the figure-of-eight bandage. To apply the figure-of-eight to the knee, the free end of a roller bandage two and a half inches in width and five yards in length is secured to the upper part of the lower third of the thigh by two or three circular turns. The

Bandage is then brought down over the outer condyle of the femur and across the lower part of the popliteal space; a circular turn is then taken around the upper part of the leg below the head of the fibula, and the roller carried obliquely upward across the inner condyle over the previous turn and around the lower part of the thigh. These turns are repeated, ascending toward the knee from the leg, and descending toward the knee from the thigh, and terminated by one or two circular turns over the patella (Fig. 258).

**BANDAGE OF FOOT COVERING THE HEEL.**—The end of a roller two inches wide and seven yards long is secured above the ankle by two circular turns; the roller is then passed obliquely over the foot to the metatarso-phalangeal articulation, and after a circular turn about this part is carried up the foot by spiral or spiral reversed turns until the ankle-joint is reached, when a circular turn is made

FIG. 259.



Bandage of foot covering the heel.

FIG. 260.



Bandage of foot not covering the heel.

(Wharton.)

about this part and the heel. It is then passed over the foot, beneath the instep, around the heel, and to the other side of the foot; thence over the foot, beneath the instep, around the heel from the opposite side, and forward over the foot. From this point it may be terminated by circular turns or continued to the leg (Fig. 259).

**BANDAGE OF FOOT NOT COVERING THE HEEL.**—The end of a roller two inches wide and seven yards long is held above the ankle by two circular turns; the bandage is then continued over the foot to the metatarso-phalangeal joints, and thence up the foot by spiral or spiral reversed turns to the ankle, about which several figure-of-eight turns are made, and the end secured by two circular turns, or it may be extended over the leg in part or completely (Fig. 260).

**T-BANDAGE OF THE PERINEUM.**—This bandage may be applied either single or double, and is useful in retaining dressings to the genitalia, perineum, or the sacral region. In its application the circular strip is passed around the body above the iliac crests and the ends securely fastened in front. The vertical or perineal strips are then brought forward between the thighs and pinned or tied to the circular band in front.

**MANY-TAILED BANDAGE.**—This bandage is made according to the part to which it is to be applied, each side overlapping about six inches. The sides are torn into strips about two inches wide; the bandage is then slipped beneath the part, and the first strip at one end is brought obliquely upward if beginning at the lower end, and downward if at the upper end; the corresponding strip of the other side is next laid smoothly over this and the second one brought up in like manner as the first, and so on until done; then it is firmly pinned or sewed.

### LOCAL APPLICATION OF COLD.

Since Schüller showed that the application of ice to the dura mater of a rabbit for ten seconds was followed by marked contraction of the arteries and veins of this structure lasting thirty seconds, cold has been very extensively used in treating conditions in which the amount of blood in the part is to be diminished. It may be applied dry, wet, continuous, or intermittent.

The indications for its use are to produce local anæsthesia (see Local Anæsthetics), to contract the vessels in inflammation, and to relieve pain, swelling, and tension; it is also of value in some cases of hemorrhage.

**Dry Cold.**—Dry cold may be applied locally by means of an ice-bag partly filled with cracked ice, each piece being no larger than a walnut. In order that the bag may adapt itself to the part it should be about one-third filled. If a rubber bag cannot be obtained, a pig's bladder makes a good substitute. A layer of flannel should be interposed between the bag and the skin. Leiter's tubes, or ordinary rubber tubing encircling a limb and draining ice-water from a reservoir, will also act admirably.

**Wet Cold.**—A simple and efficient method of applying wet cold to an extremity is as follows: wrap the part loosely with a wide flannel bandage and place the limb upon a Kelly pad, the apron of which should rest in a pail on the floor. A pail filled with cold water is placed beside and above the patient's limb. One end of a long, wide, wet lamp-wick is placed in the reservoir; the other end is

brought in contact with the limb, and by capillary attraction and gravity the extremity will be kept wet. Tap-, spring-, and ice-water may be used. If ordinary tap-water is used, its effects may be enhanced by the addition of one part of alcohol to four or five parts of water. An antiseptic agent may be added to the water if desirable.

**Cold Compresses.**—Pledgets of cotton, wool, or lint soaked in ice-water are known as cold compresses, and are employed in the treatment of localized inflammations, such as conjunctivitis and epididymitis. To be effective they must be kept cold and changed frequently. Cold is a very serviceable agent, but its injudicious use may cause extensive sloughs and even gangrene. Caution in its use is advised in old or very feeble people, and in advanced inflammations or highly congested areas.

### LOCAL APPLICATION OF HEAT.

Heat is used to cauterize the tissues, to disinfect an area, to arrest inflammation, to mitigate pain, to cause relaxation of tissues, to arrest hemorrhage, to destroy malignant growths, and sometimes to allay itching.

**Dry Heat.**—Heat may be applied locally in the dry state by means of a specially devised apparatus known as the oven. It is of value in the treatment of chronic joint-inflammation. Leiter's coils may also be used to apply dry heat to a given area. These coils are made of various sizes, to correspond in shape to any special organ, and after being placed upon it, hot water is made to flow through the coil. A convenient way of applying dry heat is by heating to the required degree an iron, brick, a bag of salt, or some other material that will hold heat. Before such agents as the above are placed on the part they should be covered with a piece of flannel. Most physicians prefer the hot-water bag as a means of supplying local heat. The bag is filled with hot water, the cap is screwed tightly on so as to prevent leakage, and the bag covered with flannel. In applying local heat to a patient who is unconscious, paralyzed, or in a state of shock, great care must be exercised lest a serious burn result.

**The Actual Cautery.**—One of the most convenient and useful devices we have for cauterizing tissues is the apparatus known as the Paquelin thermocautery (Fig. 261). This instrument consists of a hollow handle, three movable hollow platinum cauteries, two pieces of rubber tubing, a Richardson spray-bellows, a bottle containing benzine, and a spirit lamp. When the apparatus is to be used, one of the cauteries is screwed to one end of the hollow handle, while the other end of the handle is attached to the bottle by means of one of



the pieces of rubber tubing; the other piece of tubing serves to connect the Richardson spray-bellows with the bottle. The tip of the cautery is then held in the flame of the spirit-lamp until heated to blackness. The spray bellows is now put in action by compressing the distal rubber bulb with the hand, and benzine vapor is forced into the cautery, where it ignites and keeps the cautery at the desired heat.

If the benzine vapor is introduced into the cautery while the tip is insufficiently heated, it will be found impossible to raise the point to the proper degree of redness; but if handled properly the point

FIG. 261.



Paquell's cautery. (Wharton.)

can be kept at a red heat for an indefinite period, and will afford a ready means to destroy tissue and infection as well as to arrest hemorrhage in certain cases. If vigorous counter-irritation is indicated, the point must be heated to a white heat.

When this instrument is used to arrest hemorrhage, the tip should be kept at a cherry-red heat by intermittent compression on the bulb. Before applying the cautery to an area which is bleeding pressure should be made with a gauze pad for a few seconds, to secure dryness of the field; after the pad is removed the cautery is quickly applied.

**The Galvanocautery in Cavities and Canals.**—The best way of securing cauterization in body-cavities or canals is by means of the galvanocautery, as the electrode can be introduced while cold, and after it has reached the spot to be acted upon may be heated to a white heat. To operate a galvanocautery, a cautery battery which

will keep an electrode at a white heat for an indefinite time must be used. Electrodes are made in the shape of probes, snares, and blades.

When special apparatus is not at hand, an ordinary poker can be heated in a kitchen range and used.

**Moist Heat.**—The methods of applying moist heat are by hot fomentation, poulticing, bathing, and douching. Fomentation is the application of cloths soaked in hot solutions, and is used to promote absorption, to restore the circulation of a damaged part, to reduce inflammation, and to allay pain. In dealing with sloughs, the separation of the necrosed tissue will be hastened, and the vitality of the tissues whose recovery is possible will be encouraged, by hot antiseptic fomentations. The hot antiseptic fomentation is made by ringing out gauze from a hot 1:1000 solution of bichloride of mercury, and while hot placing on the part to be treated and covering it with rubber dam.

A fomentation can be kept warm for hours by the use of a hot-water bag over it. The hot antiseptic fomentation makes an ideal poultice, as it furnishes the essentials—heat and moisture—acts as a germicide, and contains no ingredient that will decompose.

**Poultice, or Cataplasm.**—Many materials have been recommended for making poultices; flaxseed meal, slippery-elm bark, bread and milk, and charcoal have in days gone by been very popular; but since the introduction of antiseptics the old-fashioned poultice is being replaced by the hot antiseptic fomentation as previously described. In preparing a poultice, the material to be used is slowly incorporated with hot water until a paste of the proper thickness is made; the mixture while hot is spread between two layers of muslin or cheesecloth and applied. The heat and moisture can be retained for five or six hours by covering the outer surface of the poultice with rubber dam, waxed paper, or oiled silk. If poultices be kept in contact with the skin for a long time, they lower the vitality of the part, and vesication or pustulation may result. The proper poultice to use on an open wound or an area which is to be subjected to an operation is the antiseptic fomentation.

**Water-bath.**—The hot bath is used by some in treating burns, sprains, and phagedæna. A hot bath will sometimes relieve muscular spasms, though it must be remembered that a temperature of 100° or 120° F., if continued longer than a half hour, will cause marked depression.

If a strain of a joint is seen early, it can be treated most satisfactorily by subjecting it to the hot-water bath. In such cases the extremity is placed in a bucket of water as hot as can be borne, and small quantities of boiling water are added from time to time to maintain the proper temperature. By adding the boiling water

gradually the limb will become accustomed to a very high degree of heat.

**The Hot Douche.**—Hot douching is a procedure which consists in directing a stream of hot fluid either from a pitcher with a long beak or from a funnel which is connected with a glass nozzle into or against various parts of the body. It may be employed in cavities and to flush wounds after operations. It is also of service in treating stiff joints where the trouble is muscular or ligamentous. Capillary hemorrhage can be arrested by douching the bleeding surface with a hot solution. A fountain-syringe can be utilized to douche the vagina and the rectum, and for cleaning these cavities the saline solution and mild antiseptic solutions, such as boric acid and creolin are useful. For disinfecting the vagina a 1 : 500 corrosive sublimate solution may be introduced by means of a douche-bag. In the presence of hydrogen sulphide corrosive sublimate is useless, the inert and insoluble sulphide of mercury being precipitated; hence corrosive sublimate is without value as a rectal antiseptic. The general solution to be used in a douching apparatus is a normal saline solution made by adding one drachm of common salt to one pint of water. This solution acts mechanically in removing blood-clots, mucus, and detached fragments of tissue. Its presence also stimulates the body-cells, rendering them capable of antagonizing bacteria.

### SORBEFACIENTS.

Sorbefacients are agents which cause exudates to be softened and absorbed. Their use is indicated in inflammation of glands, joints, tendons and their sheaths, muscles, and periosteum.

The agents which are most commonly used to produce absorption are: ichthyol, tincture of iodine, blue ointment, the hot and cold douche, intermittent heat, and massage. In the Outpatient Surgical Department of the Jefferson Medical College Hospital, the hot and cold douche, massage, and ichthyol are used in combination in treating old contusions, chronic inflammations about joints, and the stiffness of muscles and tendons which results from fractures and dislocations. In employing this treatment, a pitcher of cold water is poured slowly from a distance of three feet upon the part to be treated. This is followed by an equal amount of very hot water directed on the spot in the same manner. The part is then vigorously rubbed, first with a Turkish towel, then with the hands. The treatment is completed by rubbing one-half of a drachm of 5 per cent. ichthyol ointment into the part. The above procedure may be carried out at night and morning.

The following are favorite prescriptions used in the Jefferson Medical College Hospital in the treatment of enlarged lymphatics, tenosynovitis, and periostitis :

**For children—**

**R** Ichthyol., 3ij;  
 Lanolin., ʒj.—M.  
**Ft. ung.**  
**Sig.** Apply locally night and morning

**For an adult—**

**R** Ichthyol.,                                ʒiv ;  
       Lanolin.,                                ʒj.—M.  
**Ft.** ung.  
**Sig.** Apply locally night and morning.

After the ichthyol has been applied cover the part with waxed paper or rubber dam and apply a bandage. Ichthyol, like other ointments, is wasted and the part deprived of its good effects by being covered with lint, which readily absorbs the agent.

Ichthyol stains white goods, and to some individuals its odor is disagreeable; but the staining can be prevented by a proper covering, and the odor can be masked by adding to each ounce of the ointment  $\text{mxx}$  of the oil of citronella (Hare).

## COUNTERIRRITANTS.

**A counterirritant is an agent which, when placed upon the surface of the body, produces a superficial aseptic inflammation.**

It is resorted to occasionally to affect superficial and deep-seated morbid processes, and acts in such cases by attracting an increased amount of blood to one part of the body, thus lessening it in other parts. According to Hare (*A Textbook of Practical Therapeutics*), the indications for counterirritation may be classified as follows:

**First**, for influencing inflammations or congestions ; **secondly**, for causing the absorption or removal of inflammatory deposits after true inflammation has ceased ; **thirdly**, for the relief of pain ; and, **fourthly**, for the effect upon the general system, as in use of blisters in systemic disease. Hare also says that we may divide counterirritants, according to their effects, into three forms, each having a different degree of severity : the caustics, or escharotics ; the epispastics, or blisters ; and the rubefacients, or reddeners.

**Cauterants.**—When very pronounced counterirritation is indicated, it may be induced by the tip of a Paquelin cautery or a poker



heated to a red heat. The point of the instrument is applied to skin at several spots or may be lightly drawn across it in various directions. Extensive sloughing may follow counterirritation by above method if used over a bony prominence, or it may cause neuritis or exposure of the nerve if applied over an important nerve trunk. Secondary hemorrhage is liable to follow the use of any form of irritation near a large bloodvessel.

**Epispastics.**—Epispastics cause blisters, and are used in inflammatory affections, such as pleurisy, pneumonia, iritis, neuritis, arthritis, and in many other conditions; but they should not be applied to an inflamed area of the skin. A blister, also, should not be formed too near an inflammation. For example, cerebritis and meningitis are benefited by applying epispastics on the nape of the neck. For an inflamed joint, the blisters should be raised at some distance from the swelling.

A blister may be produced by soaking a bit of absorbent cotton in chloroform, and, after placing it on the surface, covering it with watch-crystal; or by applying the blade of a table-knife, previously introduced into boiling water, for several seconds to the skin.

Parts of lard and ammonia will blister if allowed to remain on the skin for five minutes. Deep-seated pain is sometimes relieved by painting the area immediately over the painful spot with cantharidal ointment.

When the above methods fail to produce blistering, the cautery-poker heated to a red heat will suffice. When the blister is fully developed, it should be punctured with an aseptic needle, and a mild ointment applied to promote healing. If it is to remain open, however, the elevated tissue should be removed with a pair of forceps and scissors, and nitric acid with cosmoline (gtts. xj-5j) applied.

**Rubefacients.**—These agents produce redness of the skin. They can apply counterirritation to the condition of redness by the use of the spice-bag, capsicum, turpentine, or mustard. The spice-bag is a reliable and mild domestic means of inducing counterirritation. It comes in direct contact with the skin, and is not so uncomfortable as most rubefacients. It is made by mixing equal parts of powdered cloves, cinnamon, nutmeg, and allspice, and one-half part of black pepper. After mixing, these ingredients are sewed up in a cloth bag, and the bag quilted to keep the mixture spread out as far as possible. One side of the bag is wet with vinegar or whiskey, and the entire bag is dipped in hot water and then placed upon the skin. For the treatment of pain in the abdomen or chest, the most commonly used rubefacient is ground mustard made into a plaster. Ready-prepared mustard-plasters can be purchased at drug-stores and are applied to the surface after they have been dipped in water; a piece of cheesecloth should be interposed between the

and the plaster. The domestic mustard-plaster can be made by mixing mustard-flour with vinegar, but wheat-flour or flaxseed-meal should be added to modify its action. In a child or an adult with a tender skin, one part of mustard is added to three parts of flour or flaxseed-meal. Most adults tolerate the application of equal parts of mustard and flour, which should be made into a paste by the addition of warm vinegar or tepid water. The mixture is spread on cloth, then covered with cheesecloth, laid upon the part and kept on until the patient complains. If vesicles follow the application of the mustard, they should be punctured with a clean needle and dressed with zinc ointment. The long-continued action of mustard will cause sloughing, and counterirritation should never be allowed to proceed beyond the stage of rubefaction.

Turpentine is a powerful rubefacient, and is used in the form of a stupe, which is very effective in the treatment of colic and certain bronchial troubles, and is prepared by folding several layers of flannel, wringing this out of hot water, sprinkling upon it ten drops of spirit of turpentine, laying it upon the surface, and holding it in place with a bandage or binder.

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#### THE TREATMENT OF THE VARIOUS FORMS OF SUPPURATION.

Suppuration is that termination of inflammation in which pyogenic bacteria exercise a peptonizing action upon the tissues and exudates, thereby converting them into pus.

Suppuration may be localized or diffused. The localized form is due chiefly to the action of staphylococci. These bacteria are responsible for boils, felons, abscesses, and carbuncles. In diffused suppuration a wall of embryonic tissue has not had time to form; hence the bacteria (streptococci) are not imprisoned, as in the other variety, but are free in the lymph-spaces, and the inflammation and suppuration caused by them are sometimes widespread and alarming (Fig. 262).

The symptoms of acute suppuration vary with the location of the pus, special regions giving rise to special symptoms. Acute superficial abscesses are marked by symptoms of inflammation plus pointing, and if they are large fluctuation exists. The skin over a deep abscess is brawny and the tissues are œdematous, but fluctuation is prevented in most cases by the presence of unyielding fascia. The constitutional symptoms of acute suppuration are in proportion to the amount of toxins absorbed.

Suppuration is generally ushered in by a feeling of chilliness, or there may be a distinct chill. The temperature may be intermittent,

remittent, or continuous, and in a subdural abscess following ear disease it is more frequently normal or subnormal. Pus

FIG. 262.



Diffused cellulitis of the hand, forearm, and arm.

FIG. 263



Hilton's method for relieving pus in regions where there are large bloodvessels.

of no use. It is a hidden enemy, and should be sought for and evacuated when symptoms indicating its presence are manifest. When pus is confined in the vicinity of large bloodvessels it



be liberated by Hilton's method. To evacuate an abscess by this method, incise the skin and deep fascia, and through this incision introduce the blades of a pair of forceps (closed). Then push the forceps gently in different directions, and withdraw them with the blades open. The blunt end of such an instrument will glide past important structures, and a good opening is effected by the removal of the forceps with the blades open (Fig. 263).

FIG. 264.



Osteomyelitis of the proximal phalanx following an amputation for necrosis caused by a felon.

A furuncle, or boil, is a mild form of localized suppuration. It is caused by infection introduced into the deep layer of the true skin and subcutaneous tissue. This infection may enter through abrasions or may result from an infected hair-follicle. According to Warren, the core of a boil consists of a sebaceous gland and a hair-follicle which have undergone coagulation-necrosis. Successive crops of boils happen in Bright's disease, infectious fevers, gout, tuberculosis, and diabetes. The treatment of a boil consists in incising, removing the core (if detached) with a pair of forceps, irrigating with peroxide of hydrogen, and applying dressings. After a boil has been incised, hot



antiseptic compresses will mitigate the pain and hasten the liberation of the core.

A felon, paronychia, or whitlow, is an acute abscess of the finger or toes, and is due to infection by pyogenic organisms. It is commonly seen in carpenters, butchers, housemaids, and other persons whose occupation exposes them to traumatism of the hands or feet. According to Stoneham, felons are usually divided into four varieties.

(1) Subepidermic whitlow is a collection of pus beneath the epidermis, and usually involves the ungual phalanx. When the e

FIG. 265.



Lines showing the locations for making incisions in suppurations of the fingers and for two-thirds of the palm. The transverse lines show the location of the creases. The U-shaped lines show the positions of the palmar arches.

dermis has been removed a minute opening may be found extending into deeper structures.

(2) Subcutaneous whitlow is commonly seen at the ungual phalanx, often at the bed of a nail.

(3) Paronychia tendinosa is a term applied to the condition when the inflammation attacks the tendon-sheath.

(4) Subperiosteal whitlow, which is really a suppurative periostitis, and is usually consequent to the spread of the inflammation to the deeper structures.

A felon may cause necrosis of the bones of the fingers (Fig. 266).

and from it infection may spread through the tendon-sheaths of the little finger and thumb, and cause an abscess of the palm; complete disorganization of the joints of the fingers may result from a felon, and loss of the nail is frequently seen. Adenitis of the axillary glands and lymphangitis of the forearm are not unusual in a deep felon. A felon, whether it be deep or superficial, should be opened early. Delay means destruction. Throbbing pain is an indication for immediate incision.

In dealing with a deep felon, open it to the bone by an incision alongside the tendon (Fig. 265). The pain of superficial felons can be relieved by the spray of chloride of ethyl; but a deep felon should be opened while the patient is under the influence of nitrous oxide or in the first stage of ether-anaesthesia. After a felon has been opened, apply a hot antiseptic fomentation to the finger and place the entire hand on a splint. Inflammation of the ends of the fingers and toes may lead to gangrene, which fact should be remembered in using carbolic lotions in these conditions, as this acid tends to increase this tendency.

#### ABSCESS.

An acute abscess is a circumscribed abnormal cavity containing pus, which pus is confined by a wall of embryonic tissue. Pus in the gall-bladder, cerebral sinus, pleuræ, pericardial or peritoneal cavity is spoken of as purulent effusion; but if any of the above normal cavities should contain pus, confined by a wall of inflammatory tissue, the

FIG. 266.



Palmar abscess and diffused suppurative cellulitis of the forearm.

condition would then be termed an abscess. An abscess may be superficial or deep.

A superficial abscess lies in the skin and the tissues immediately beneath it. A deep abscess forms under the deep fascia. If the cavity of a deep abscess communicates with the cavity of a superficial

abscess through a minute opening in the deep fascia, the condition known as a "shirt-stud abscess."

In the treatment of an abscess wherever found the golden rule should be, open by a free incision, irrigate with warm saline solution, and, if the abscess be large, drain with a tube either of glass or rubber, as gauze will not drain pus, and drainage in some cases should be continued until the discharge becomes thin and serous. The hot anti-septic fomentation makes an admirable dressing for the abscess after the pus has been evacuated.

**Palmar Abscess.**—A palmar abscess (Fig. 266) is such a common and dangerous disorder that special reference is made to this section.

If the anatomy of the hand be considered, it is easily seen that abscesses occur so frequently in this portion of the body, which is constantly exposed to traumatism. According to Warren, the

anatomical arrangement of the connective tissue fibres on the palmar surface of the hand and fingers is such that they run perpendicularly inward to the palmar fascia or the sheaths of the tendons, and therefore, after an infection, infective material is more readily directed to the deeper parts. The peculiar arrangement of the two lateral portions of the palmar fascia predisposes to the formation of a palmar abscess if there is an infected wound on the little finger or the thumb (Fig. 267). These portions are thin, fibrous layers, one going to cover the tendons of the little finger, the other to cover the tendons of the thumb. These

FIG. 267.



form a path of least resistance along which infection may easily spread from either the thumb or the little finger to the palm. Calluses, which are developed in the palm of the hand by constant friction from work, frequently become fissured and allow the entrance of infection. Pulsating pain in the palm, slight swelling, and circulatory disturbance are indicative of a palmar abscess. The symptoms must not depend upon fluctuation, discolorations, or great tumefaction, as these symptoms are often absent in this condition. If pus in the palm under the deep fascia be allowed to take its own course, it will dissect the structures of the palm and may penetrate to the deep, but will most probably work its way beneath the anterior annular ligament of the wrist into the connective tissue of the forearm, and

then spread like wildfire and cause a diffused suppurative cellulitis (Fig. 268). At this stage constitutional sepsis is very likely to occur, and the patient is in great danger of his life. The very best prognosis will often be that of a useless arm. Pus beneath the deep fascia

FIG. 268.



Dorsal surface of the hand in a palmar abscess.

should be evacuated by a free incision while the patient is anaesthetized. An incision beginning at a point below a transverse line from the web of the thumb across the palm and running toward the fingertips will clear the palmar arches and do little or no damage to the

FIG. 269.



Counteropening and draining with rubber tube in palmar abscess.

tendons and bloodvessels. Hilton's method (Fig. 263) may also be employed. After a free incision has been made irrigate the cavity with a hot saline solution, introduce a short rubber drainage-tube, and apply a hot antiseptic fomentation. The hand should be dressed



on a splint and supported by a sling. When the abscess is of so duration several incisions may be required, and counteropening above the wrist and on the dorsum of the hand are at times necessary to secure free drainage (Fig. 269). The constitutional symptoms which accompany an abscess of the palm are best treated by rest in bed, light diet, twenty drops of the tincture of chloride of iron three times a day, free stimulation, and five grains of quinine night and morning. So soon as the suppurative process has begun to subside passive and active motion should be instituted and continued until the patient has free use of the fingers. The early use of these movements should be insisted upon, as delay will mean a stiff and useless hand.

#### CARBUNCLES.

A carbuncle is a localized and circumscribed mass of inflamed and necrosed tissue, due to the action of pyogenic organisms, which gain entrance to the deeper layers of the true skin and subcutaneous tissue through a hair-follicle, a sebaceous gland, or a sweat-gland. It is generally oval or circular in shape, and is most frequently located under the thick skin of the neck, back, or buttocks. The surface presents many small openings, some blocked by threads of dead tissue, others discharging pus. The overlying skin is livid, congested, boggy and œdematous to the touch, and soon ulcerates.

The diagnosis of a carbuncle is made from its appearance, its location, the multiple necrotic foci, and the constitutional involvement. The prognosis of carbuncle on the face, neck, and scalp is always serious, as a septic phlebitis may result and infected emboli be carried to different parts, giving rise to new areas of suppuration. In advanced age the patient dies of exhaustion or septicæmia. As this condition frequently occurs in diabetics, the possibility of the development of diabetic coma must be kept in mind and a guarded prognosis given.

In the treatment of carbuncle, when possible, the patient should be fully anesthetized and the infected area excised. If much tissue is involved, this cannot be done; but in such cases much can be accomplished by free crucial incisions through the indurated mass and removal of the dead and necrosing tissue with the scissors and forceps; a small, sharp spoon should be used to curette pockets. This will cause free bleeding, which may be admirably controlled by hot antiseptic compresses held firmly against the wound. Pure carbolic acid applied to the part will destroy the infection. For the first few days the wound should be dressed twice daily with hot antiseptic fomentations; and when the wound presents a healthy appearance it may be treated with a mild, stimulating ointment, or skin-grafts may be employed.

Sleep is to be secured by morphine, and stimulation by quinine, milk-punches, and a nourishing diet.

In diabetic patients it is unwise to do an extensive operation. Multiple incisions should be made to relieve tension, hot antiseptic fomentations should be applied locally, and careful attention given to the diet and constitutional treatment.

### HYPODERMOCLYSIS.

Mild cases of shock, hemorrhage, and infection can be benefited by the introduction of a hot sterilized saline solution into the sub-

FIG. 270.



Hypodermoclysis.

cutaneous cellular tissue. A favorite place for giving hypodermoclysis is in the tissue beneath one of the mammary glands (Fig. 270).

Some prefer to give it in the subcutaneous tissue of the loin, buttock or the scapular region. The fluid can be introduced by means of a fountain-syringe which has attached to it a sterilized hollow needle. The skin over the selected area is disinfected, the reservoir of the syringe is filled with hot sterilized salt solution (a heaped teaspoonful to a quart of water), the needle is forced into the subcutaneous tissue and the fluid is allowed to enter. Gentle massage of the infiltrated tissue will hasten absorption, and more than one pint should not be given in one place at a time. After a sufficient amount has been introduced the needle is removed and the puncture is closed with collodion.

In giving hypodermoclysis care should be taken not to introduce any of the saline solution into the skin itself, as such a procedure may cause a slough.

#### INTRAVENOUS INJECTION OF SALINE FLUID.

The introduction of fluids into the vascular system of an individual is by no means a new procedure. Such fluids as human blood, milk, artificial serum, blood mixed with vegetable juices, and blood from animals have been used.

The experimental research on the intravenous injection of various solutions by M. M. Bosc and Vedel<sup>1</sup> is interesting. The authors experimented with the following solutions: distilled water, ordinary water, simple saline (chloride of sodium) solutions, and the so-called artificial serum, sodium chloride and sulphate of sodium (equal parts of a strength of 7 : 1000). Their conclusions are as follows: distilled water is noxious even in small doses, and should not be injected alone into the veins. Ordinary water is, on the contrary, not so. Its destructive effects on the red corpuscles are less marked than those produced by distilled water, and in emergency it may be injected intravenously by itself. Simple sodium chloride solution is quite innocuous so long as the quantity of salt does not exceed thirteen times the quantity of the sodium chloride contained normally in blood. The physiological value of the artificial serum solution is not superior to that of the simple saline solution, and simple saline solution (7 : 1000) is the most convenient for intravenous injection.

William Hunter, in his admirable address<sup>1</sup> on transfusion delivered at the Royal College of Surgeons, London, said: "The advantage that transfusion of red corpuscles may have over simple saline injections is counterbalanced by the dangers attending the same."

<sup>1</sup> British Medical Journal, vol. 11, 1889.

<sup>2</sup> Ibid.

ultaneous injection of the white corpuscles. In the case of defibrinated blood the latter so preponderate that the transfusion of defibrinated blood is an operation not only dangerous in itself, but one whose practical value by no means serves to compensate for the additional risks run in carrying it out. Under no circumstances is transfusion of milk or of other mixtures possessing what are supposed to be nutritive properties ever indicated. They possess no value not possessed by an equal bulk of saline solution." Hunter also said that his experiments upon animals show that the recovery after intravenous injection of the saline solution is remarkably rapid. The time required for the return of the red corpuscles to their original number after loss of blood, without subsequent transfusion of blood, varies from two to three weeks. With subsequent injection of simple saline solution it is the same; whereas with subsequent transfusion of blood complete recovery is delayed a week or more. Further, what is perhaps more striking and certainly is of more importance, is the fact that during the subsequent recovery the animals generally appear to be in better health after intravenous injection of the saline solution than after transfusion of blood. The intravenous injection of the saline solution is, then, to be recommended above all other operations in cases in which there is a fall of blood-pressure due to the excessive loss of blood. Its use is also indicated during severe operations as a preventive of traumatic anæmia and in uræmia. In shock it supplies heat to the vital forces, and gives the heart something to contract upon until the nervous system either in whole or in part recovers itself. The injection of the normal saline solution can also be used with advantage in cases of sepsis and suppression of the urine. While a severe operation is being performed upon a patient who has inactive kidneys much can be done to prevent uræmia by introducing warm saline solution during the operation. The quantity of the saline solution to be injected varies according to the age, the amount of blood lost in cases of hemorrhage, and the reaction-signs in cases of shock and collapse. In cases in which there has been considerable blood lost the amount should be greater than in cases of collapse or shock. The quantity ranges from a few ounces up to three or four quarts. The chief guides in any case are the return of the pulse, with increase in volume and diminution in rate, and the return of color, facial expression, and consciousness.

The temperature of the solution should be kept at about 110° F. while injecting. A convenient way of handling the solution is as follows: have three quarts of a cooled boiled solution containing twelve drachms of common salt. When the time arrives to administer a saline solution take a small quantity of this solution and add to



it a little more than an equal amount of boiling water ; the solution will then be ready to inject. The fluid should be forced in gently, and the pulse should be carefully watched for fear of overloading the vessels. Strict attention should be continuously given to the pulse and respiration in cases of shock and collapse treated by this method. Where this treatment has extended over a considerable period and the quantity injected has been large, the condition of the bladder should be looked after. The technique of the operation is simple.

While any large superficial vein might be used to receive the solution, the median basilic has in the large majority of cases been selected. In some instances, owing to the collapsed condition of this vein, it cannot be identified. The outline of the vein can be made prominent if a moderately tight bandage be applied around the arm just above the elbow and then have flexion and extension performed at the wrist. These movements will increase the blood-flow and distend the wall of the vein.

After the parts have been thoroughly cleansed and the forearm placed in a position of supination, an incision one inch in length should be made over the vein at the bend of the elbow and carried through the skin and superficial fascia. This incision will bring into view a layer of fat, which is very often seen and very rarely spoken of in text-books. With a blunt instrument the fat should be torn through and the vein exposed. If the Collin apparatus, or an ordinary glass funnel with tubing and canula attached, is to be used to convey the fluid, three catgut ligatures should be placed under the vein, and one of the ligatures should be drawn well down into the lower angle of the wound and immediately tied. An opening just large enough to receive the canula should be made in the vein-wall above the point where the ligature was tied. Into this opening the end of the canula is introduced. A second ligature is now tied around that portion of the vein which includes the end of the canula. This ligature not only holds the instrument in place, but also prevents the entrance of air. After the required amount has been injected the third ligature should be tied in the extreme upper angle of the wound above the end of the canula. The canula can now be taken from the vein, or that part of the vein between the upper and lower ligatures can be excised, removing the excised portion of the vein with the canula in situation. The wound needs no drainage, is closed with several silkworm-gut sutures, and aseptic dressings applied.

The saline solution can be injected into the vein with the Spencer Collin apparatus (Fig. 271). If this apparatus be used, constriction above the elbow is made ; the arm is disinfected ; the reservoir (Fig. 271, 1) is filled with the hot sterilized saline solution ; a small incision is made over the vein, and a catgut ligature is placed about the vein,

in the lower angle of the wound, but not tied; the vein is then punctured with the pointed canula (Fig. 271, 2). This canula fits over a blunt-pointed canula (Fig. 271, 3). After the pointed canula has made an opening in the vein wall it is slipped back, and the point of the inner canula, which has a blunt end and is harmless to the inner wall of the vein, is uncovered; the ligature is now tied. The piston

FIG. 271.



Spencer Collin's portable infusion apparatus, consisting of a nickel-plated, flat-shaped reservoir, five and a half inches high by four inches long by one and five-eighths inches wide, to the bottom of which is attached a force-pump, with glass barrel surmounted with fenestrated metal cylinder, also tubing and canula with canulated needle. The pump is detachable, thus permitting the various parts to be carried inside the reservoir, thereby making a most compact apparatus. All parts can be sterilized.

is put in action and the required amount injected. The canulae are then removed and the wound is covered with an antiseptic compress, which is held in place by a firm bandage which should include the hand.

### ASPIRATION.

A hollow or grooved needle and the trocar have been favorite instruments for evacuating fluids from normal and abnormal cavities; but of late the instrument most generally employed is that of Potain, as with this aspirator air which might contain harmful bacteria can be excluded from the cavity. Potain's aspirator consists of an exhausting-pump, a large glass bottle, two pieces of rubber tubing, a canula carrying a fine trocar, and a rubber stopper into which is introduced a metallic tube shaped somewhat like the letter Y and having a stopcock on each limb. When the apparatus is to be used the cork is placed in the bottle, one limb of the metallic tube is connected with the canula by means of one of the pieces of rubber tubing, and the other limb is connected with the pump by the other piece of

tubing (Fig. 272). This instrument is used for diagnostic and therapeutic purposes.

**The Use of the Aspirator in Chest Effusions.**—In pleural effusions aspiration is largely employed for diagnostic purposes, or as a temporary measure when dyspnoea is great, or when thoracotomy is contraindicated. In very large effusions a radical operation can be done more safely if part of the fluid is aspirated several days before the operation is to be performed.

Effusions following pneumonia in children are occasionally cured by aspiration, and it sometimes effects a cure in encysted empyema.

FIG. 272.



Potain's aspirator. (Wharton.)

The technique of paracentesis thoracis with the Potain aspirator is as follows: the aspirator is made ready for use and a vacuum in the bottle is secured by turning off the stopcock which is on the canula side of the metallic tube, and turning on the stopcock which is on the pump side of the metallic tube; then pumping the handle of the syringe thirty to fifty times and turning off the stopcock, thus maintaining a vacuum in the bottle. An area in the vicinity of the anterior border of the angle of the scapula is disinfected. The operator's hands, the patient's skin, and the trocar and canula are rendered aseptic; after this the upper border of the sixth rib is marked by the surgeon's left index-finger, and the trocar, guarded by the index-finger of his right hand, is entered in the fifth interspace and in front of the angle of the scapula. The trocar is now withdrawn from the canula and the stopcock on the canula is turned off. The fluid is aspirated from the chest into the bottle after the stopcock on the canula side of the metallic tube is turned on. Before aspirating, the patient should be given a little whiskey and, if necessary, a hypodermic



injection of strychnine. He should rest in the recumbent position, with the arm hanging at the side. The opening made by the needle should be covered with iodoform collodion. The risks of paracentesis are syncope, shock, embolism from clots in the vessels, and œdema of the lung.

Jacobson says that the aspiration of a large effusion from the chest is an undoubted danger, and is occasionally followed by œdema of the lung, which terminates fatally in about twenty-four hours. He speaks of Duffin's explanation of the phenomenon as probably the correct one. After the removal of a large effusion the compressed lung corresponds to a limb after the use of Esmarch's bandage. The vasomotor nerves are paralyzed, and when the lung expands sudden stress is thrown on the paralyzed vessels; hence the transudation of sero-albuminous fluid, equivalent to the oozing so common after removal of the bandage.

**Suprapubic Aspiration.**—Temporary relief can be given by suprapubic aspiration to a person who has retention of urine from an impassable stricture or from an enlarged prostate which prevents catheterization. It occasionally happens that after a bladder has been aspirated in these conditions a catheter can be passed, because the tension has been removed from the posterior part of the urethra. The bladder may be aspirated several times in succession; but if conditions are present which require repeated aspirations, relief should be obtained by either suprapubic cystotomy or perineal section. To evacuate a bladder by suprapubic aspiration, rigid antisepsis should be employed. The needle, guarded by the finger, is introduced just above the pubic arch in the median line. A trocar may be used, but the Potain aspirator is the safest instrument.

**Aspiration of Joints.**—Aspiration of a joint is sometimes resorted to for the diagnosis and treatment of an effusion following traumatism or gonorrhœal, tubercular, or typhoid infection. In aspirating a joint, strict antisepsis must be observed. The pneumatic aspirator is the best instrument for this purpose, as the use of the ordinary needle or trocar is more likely to be followed by infection. The needle is entered through a disinfected area, away from important nerves and vessels, and the puncture is afterward covered with an aseptic dressing.

**Paracentesis Auriculi and Pericardii.**—Paracentesis auriculi (tapping the heart cavity) and paracentesis pericardii (tapping the pericardial sac) are operations which are done only in extreme cases. The right auricle may be tapped by means of the aspirating-needle pushed directly backward in the third interspace at the right edge of the sternum. The procedure has been employed in cases of distention from pulmonary congestion, but is not recommended, as it is



highly dangerous and is of questionable value. Aspiration of the pericardial sac is sometimes resorted to when pressure of fluid interferes with the heart action. Fluid in the pericardium is reached by introducing the aspirating-needle through the fifth intercostal space two inches to the left of the left edge of the sternum and directing the instrument directly backward.

**Aspiration in Intraperitoneal Cysts and Abscesses.**—Intraperitoneal masses should not be aspirated through the abdominal wall, though aspiration is sometimes employed for diagnostic purposes. It should not be practised if pus is suspected, as the procedure is very liable to give rise to fatal peritonitis. More than one case in which the operator was on the verge of aspirating an abdominal cyst, but for some reason he operated instead. After the abdominal cavity was exposed sufficient evidence was present to show that the anterior and the posterior walls of the stomach would have been punctured if he had aspirated, as this organ was spread out by a large pancreatic cyst.

#### INGROWN TOENAIL.

Ingrown toenail is a very common disorder. The term "ingrown nail" has been in use for years, but, practically speaking, a nail does not grow in; its surface is partially covered by hyperplastic tissue (Fig. 273), which gives it the ingrown appearance. Really an ulcer, as in most cases there is a granulating surface at the side of the nail. Infection or prolonged pressure and irritation of the tissue at the side of a nail will cause this condition, induced particularly by close-fitting, pointed boots or shoes. In many cases can be treated satisfactorily by removing the cause and keeping the toe clean, and many may be much benefited by a proper shoe, washing the foot daily with warm water and castile soap, and introducing by means of a clean needle a small wisp of sterilized absorbent cotton between the nail and inflamed tissue and increasing the quantity of cotton each day. After the cotton is applied the toe should be wrapped in cloths wrung out of the following solution: acetate of lead, one drachm; tincture of opium, one ounce; and water, one pint. The bandage which is applied to hold the cloths in place should have several openings in it to allow the solution to be applied every four hours.

Obstinate cases require an operation, and in cases in which the nail and matrix are not diseased the operation can be made painless by the use of a local anæsthetic. One drachm of a 2 per cent. solution of eucaine, introduced hypodermically, in divided doses, for

transverse direction above the nail, then into the tissue of the affected side, and finally beneath the part to be removed, will render the operation painless. Five minutes after the injection the side of the nail should be divided throughout its entire extent on a line parallel

FIG. 273.



Ingrown toenail.

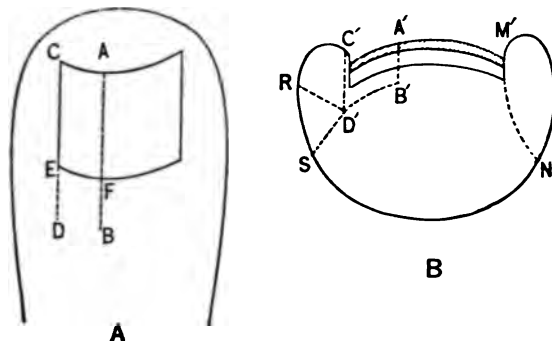
with the diseased border (Fig. 274), and this detached piece extracted ; the diseased tissue is then removed with scissors and the exposed matrix cauterized. The wound should be dressed with wet antiseptic dressings.

In recent cases in which the nail and matrix are not diseased, a cure may sometimes be effected by removing, in the long axis of the nail, an elliptical piece of skin and subcutaneous tissue ; when the gap made by the excision is closed by suture the traction exerted upon the hypertrophic tissue next to the nail will be sufficient to draw the tissue away and relieve the irritation.

If the nail and matrix are diseased, they should be removed, and

for this purpose a general anæsthetic should be given and the split up its centre with a knife or a pair of sharp seissors; each

FIG. 274.



Ingrown toenail. A, ABD'C', flap operation (parts removed shown in B, A'B'D'C'). B, wedge operation; M'N', showing part removed by Cotting's operation. (Stimson)

should then be removed with a pair of forceps, and all matrix granulation-tissue thoroughly destroyed by means of scissor curette. The wound should be treated as an ulcer.

### BEDSORES, OR DECUBITIS.

A bed sore is a necrotic area due to pressure upon a region overlies a bony prominence, and is one of the most aggravating conditions which may arise during a prolonged illness or shortly after certain injuries. Wrinkled undersheets, unequal the mattress, heat, moisture, and foreign bodies (such as crumpled clothing) strongly predispose to the formation of bedsores in patients compelled to be in the recumbent posture for a long period of time. They occur in old and feeble people, and in young patients who are confined to bed with an exhausting fever or a chronic disease. Paralyzed parts are especially prone to bedsores, and delirious and insane patients are very liable to them. Injuries associated with nerve-lesions predispose to bedsores. They are seen over the sacrum, spine, scapulæ, and occiput as a result of pressure when the patient is in the recumbent posture. In the side position they form over the malleoli, knees, trochanters, shoulders, elbows, and side of the face.

The prognosis depends largely upon the vitality of the part and the condition which confines him to bed. In paralyzed patients they are very hard to manage, and frequently go from bad to worse, and may even prove fatal from exhaustion or blood-poisoning. The early appearance of a bed sore in spinal injuries generally

cates a fatal termination. Extensive bedsores in the spinal region may cause necrosis of the vertebrae, and may extend to the spinal cord and cause a fatal meningitis. Bedsores occurring in the young during fevers and in patients with fractures of the lower extremities can usually be kept under control. They readily heal when pressure is relieved and the vitality of the patient is restored.

The appearance of a localized discoloration over prominent parts in bed-ridden patients is indicative of bedsore formation, and prompt action on the part of the attendant is necessary to prevent ulceration. In the majority of cases several days before a breach in the surface takes place the affected skin is red, rigid, and tough, and when pressed upon with the finger the displaced blood returns slowly. When digital pressure fails to displace the blood in the part, and the area pressed upon remains dusky in color and feels leathery to the touch, a grayish, greenish, or blackish slough forms, and when the slough is removed an ulcer remains.

Public infirmaries and asylums now record the number of bedsores which occur, and owing to the advance in the standard of nursing the number in such institutions is greatly decreasing.

Good judgment and energetic work on the part of the attendant will in many cases prevent a bedsore. The physician in charge of the case should see that the attendant has help in bathing, turning, and lifting the patient. A single bed with a smooth, firm, even mattress should be used. When the patient can afford it, and when his condition will permit his being moved, it is best to have two such beds; one can then be fixed and aired while the other is being occupied.

At the beginning of the patient's illness the attendant's great care should be to prevent bedsores. The patient's skin, especially over prominent parts, should be washed every four hours with hot water, soap, and a soft sponge, and dried with a warm towel; after which there should be applied a saturated solution of alcohol and alum. The covers beneath the patient should be kept smooth and dry, and free from creases, foreign bodies, urine, faeces, and wound-discharges. The under covers can be kept smooth by pinning them to the sides of the mattress. If no better means are at hand, the faeces can be prevented from coming in contact with the covers by using a newspaper covered with plenty of absorbent cotton. The urine from a man or boy can be collected in a wide-mouth bottle. A female or a patient who has a urinary fistula or a discharging wound can be kept dry by the use of plenty of good absorbing material packed about the part and changed frequently. If the patient's condition will permit, he should be turned frequently, so as to relieve pressure and allow air to the part. Pressure must be relieved by



change of position, soft pillows, air-cushions, and, if necessary, a water-bed.

If in spite of the careful nursing, localized redness appears, it may not get beyond this stage if the skin is kept clean, dry, and cool, and is protected by a rubber pneumatic cushion, and bathed twice daily with two drachms of salt to one pint of whiskey.

When the epidermis becomes detached a slough may in many cases be prevented by relieving pressure, disinfecting twice daily, and applying a solution of nitrate of silver (grains xx to the ounce of distilled water). When the skin breaks it should be treated by a spray of hydrogen peroxide, irrigated with corrosive sublimate (1 : 2000), dusted with iodoform, and covered with a piece of lint spread with zinc ointment. In advanced sores, when the odor is foul, the skin black, and a line of demarcation formed, the slough should be removed by means of scissors and forceps, and the exposed surface treated with disinfectants and a mild astringent ointment. If phagedæna appears, the part should be painted with pure carbolic acid. "A young patient covered by numerous sores may be kept immersed in a bath with a swim-collar around his neck. The water requires frequent changing, and permanganate of potassium or boric acid may be added" (Warren and Gould).

If a bed-sore appears in an old person with an intracapsular fracture, no attempt should be made to obtain union, but the thigh and hip should be immobilized by means of pasteboard splints and the patient gotten out of bed.

### FOREIGN BODIES IN THE TISSUES.

If foreign bodies are accidentally introduced into the tissues, infection ensues in the vast majority of cases, together with localized or diffused inflammation and pus-formation; but occasionally the body becomes encysted and no harm follows. Such agents as splinters, pieces of oyster-shells, and bones often give rise to disastrous consequences. Gravel, bullets, and needles may remain imbedded in the tissues indefinitely without causing inflammation. In most cases the danger is from infection, and the treatment indicated is to open the wound, extract the foreign body, disinfect, drain, and partly close the wound. If the foreign body is immediately under the skin, the wound can be sutured and drainage effected between the sutures. The x-ray is invaluable for diagnosis and for the detection of the presence of foreign bodies in the tissue. The fluorescent screen is by far the simpler method of using the rays, but if the body is deeply seated and near important structures, a skiagram should be taken and kept close at hand for reference during the operation for removal.

To locate accurately the position of the foreign body from the skiagram, the method originated by Dr. W. M. Sweet, of the Jefferson Medical College, is most satisfactory. Foreign bodies in the skin, or immediately beneath it, can be removed by the aid of a local anæsthetic, but when the body is deeply seated and near important structures, general anæsthesia should be employed.

**Blank-cartridge Injuries.**—These injuries are generally at close range; consequently powder-burns and lacerations usually are met with. It sometimes happens that the wad is blown into the tissues. The wound is always infected and there is great danger of tetanus. After such an injury the patient should be anæsthetized, and moderate capillary bleeding should be encouraged to aid in washing out infecting material. Spurting vessels must be ligated at once. Shreds of burned tissue and wadding, or any other foreign substance, should be removed. Tissue-recesses must be laid open, and the wound and the skin for a considerable distance about it must be thoroughly scrubbed with hot water and green soap, a stiff brush being used. Ether and alcohol should be freely used on the part, after which a solution of bichloride (1:1000) should be applied. If there is the slightest doubt as to the efficiency of free drainage, deep incisions into the tissue should be made (Lilienthal). No sutures should be used, and the wound should be dusted with iodoform and very lightly packed with iodoform gauze. Over this a wet bichloride dressing should be applied. Powder-grains when driven into the skin make unsightly marks, and should be removed by active scrubbing with a stiff brush and by picking out each grain with a needle. Even if the entire grain cannot be removed, the discoloration will be greatly modified by breaking it up.

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### EPISTAXIS.

Epistaxis, or bleeding from the nose, may come from one of a number of causes. It is often a very trivial matter; but in some few cases it is very serious, and may even cause death. Swoboda quotes four cases of death from epistaxis. One was a case of hæmophilia due to septicæmia in an infant with gonorrhœal conjunctivitis and rhinitis. In another case purulent rhinitis was accompanied by epistaxis. In the two others the patients had diphtheria. The author saw death from heart-clot in an alcoholic who bled from the nose for twelve hours before receiving medical attention.

A common cause of epistaxis is ulceration or a small abrasion of the septum. Traumatic epistaxis may be produced by blows upon the nose, head, or trunk, and occurs frequently in fractures of the

skull, especially when the cranial base is involved. Such growths as adenoids, angiomas, sarcomata, nasopharyngeal polypi, or foreign bodies may give rise to it. Parasites and foreign bodies may excite bleeding. Spontaneous epistaxis is liable to occur at any time in alcaptonuria, plethoric children and adults. Young people, especially girls, are prone to it about the time of puberty; and abnormal states of the blood, such as obtain in anæmia, scurvy, hæmophilia, and purpura, may cause this form of epistaxis. It is considered a symptom of various disorders, such as typhoid fever and cirrhosis of the liver; it occasionally occurs during apoplectic cerebral congestion and may arise during any febrile malady.

FIG. 275.



Plugging the nares for epistaxis by means of a soft catheter.

In many cases spontaneous bleeding from the nose is benign and should be allowed, within the limits of safety, to take its natural course. When the bleeding is persistent and before the system is exhausted to show the effects of the hemorrhage, no time should be lost in attempting to ascertain the source of the trouble. By means of the nasal speculum or the rhinoscope and a head-mirror, lesions causing hemorrhage from the nose, such as varicose veins, abrasions, and ulcers, may be located and treated with the cautery. Growths, foreign bodies, and parasites must be removed, and the hemorrhage arrested by means of



astringents, pressure, or the cauter. Iced water injected into the nostril will sometimes arrest hemorrhage. The inhalation of turpentine has been recommended; solutions of alum, hamamelis, and tannin have been used with success. The injection of hydrogen peroxide will stop the flow in many cases. Monsel's solution when used in the nose produces a foul and disgusting magma, and has no advantage over the remedies mentioned. Lint or gauze soaked in antipyrine (10 per cent.) solution or gelatin (10 per cent.) solution is a good plan of treatment.

In severe epistaxis compression in some form is necessary. If the source of the hemorrhage is from the anterior nares, it can usu-

FIG. 276.



The posterior plug in position.

ally be checked by packing one or both nostrils with iodoform gauze or gauze soaked in Carnot's solution of gelatin (gelatin, five parts; calcium chloride, one part; water, one hundred parts). Equal pressure on all sides can be induced by the use of a rubber tampon, in the shape of a small elongated rubber bag, which is introduced into the nares in an empty state, is then inflated, and is kept so until the time arrives for it to be removed. A long, thin condom used thus will often be serviceable. A special instrument, Bellocq's canula, has been devised for the purpose of introducing the plugs into the nares; or the plugs may be introduced by means of a rubber catheter passed into the pharynx through the inferior meatus. A



silk thread having a suitably sized plug of gauze is fastened eye of a catheter (Fig. 275). The catheter is then withdrawn from the nose, and the plug is drawn into the posterior naris (Fig. 276). The same procedure is carried out upon the other nostril, then both are packed from before backward, and the ends of the strings project from the nostrils are tied.

Before plugging the nares, place the patient in the modified Trendelenburg position and irrigate the nares with a saturated solution of warm boric acid. The thread, catheter, and plug should be removed. Remove the plug in twenty-four hours, and, if necessary, in a second one. If the patient is exhausted from loss of blood, intravenous injection of salt solution should be given.

As Carnot recommends the internal administration of his mixture in internal hemorrhage and in hemophilia, it may be planned to give it internally in obstinate cases of epistaxis. A 1 per cent. solution of gelatin may be given by the mouth.

### HEMORRHAGE FROM THE PALMAR ARCH

This may occur after a puncture, laceration, or a cut by such as glass or a knife. A sloughing process may extend from the tissues and effect an opening into one of the arches. Hemorrhage from one of the palmar arches is always troublesome and difficult to control.

Under no circumstances should styptics, which are known to produce rapid and extensive clots, be used. Prof. Keen reports a case in which a small aneurism of the superficial arch was injected with drops of undiluted Monsel's solution. As soon as this drug was introduced the whole hand became blanched, well-marked gangrene quickly followed, and it was necessary to amputate above the wrist. In the *Philadelphia Medical Times*, Sept. 10, 1881, p. 195, is recorded a case in which a few drops of nitrate of silver solution injected into a naevus caused gangrene of two fingers. Strong styptics applied to open wounds of the arch may produce the same results. A bandage running across the palm from the base of the hyperextended thumb overlies the superficial arch (Fig. 265). If from a wound in this region bright blood flows profusely in jets, hemorrhage from the superficial arch should be suspected. Compression is inadequate, threatens gangrene or sloughing, and it should not be relied upon. Operative measures should be instituted at once. Under the best antisepsis the hand should be made bloodless by a tourniquet. The primary wound enlarged on a line with the arch, and the ends of the arch searched for, even though extensive dissection

necessary. Every care must be taken to save the tendons and nerves from damage. A blunt instrument, such as the Allis dissector, should be used in the dissection to avoid injuring the branches of the median and ulnar nerves.

Many surgeons believe that it is unnecessary to tie the arteries in the arm or forearm for hemorrhage from the superficial or deep palmar arch.

If attempts to secure the bleeding vessel in the wound fail, it is better to ligate the brachial artery at once in the middle of the arm (Stoneham). The same authority says that ligature of the radial and ulnar arteries may not arrest the hemorrhage, or at least may do so only for a time, as the blood will be brought to the arch by the interosseous branches.

**Hemorrhage from the Deep Palmar Arch.**—The deep palmar arch lies about one inch above the superficial arch (Fig. 265), and when divided bleeds profusely. The divided ends should be sought for by an extensive dissection if necessary before ligating the brachial in continuity. A tourniquet applied to the arm will be of great assistance.

A good method for gaining access to the arch is to make an incision through the skin, starting over the upper third of the shaft of the metacarpal bone of the thumb, and running downward and inward, keeping a quarter of an inch above the line of the superficial arch and ending on the ulnar side of the hand a little below the pisiform bone. This incision will also give access to the superficial arch. A flap containing skin and superficial fascia should be dissected upward for an inch and a half, and ample room will be afforded to keep clear of important structures. The tendons should be drawn to the sides by means of blunt retractors. If the primary injury did not open widely the palmar fascia, this should be done by a blunt pair of scissors or a knife, and the margins of the fascia drawn to each side. An assistant now relaxes the tourniquet, and by the bleeding the exact location of the vessel may be seen. Both sides of the arch should be ligated with fine silk. J. Chalmers Da Costa has suggested that the deep arch might be exposed and ligated readily by the incision Mynter employs in resecting the wrist—that is, an incision separating the metacarpal bones and the bones of the wrist.

If for any reason the ends of the vessel in hemorrhage from the deep palmar arch cannot be secured, and compression proves unsatisfactory, it is best to ligate at once the brachial in the middle of the arm. In 1893 a patient was admitted to the Jefferson Medical College Hospital who had received a lacerated wound of the palm and a laceration of the deep palmar arch. Compression failed to

check the hemorrhage. Ligation of the radial and ulnar arteries failed. The brachial artery was then ligated at the bend of the elbow; this was unsatisfactory, and amputation of the hand was necessary before the hemorrhage could be stopped.

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### AMPUTATION OF THE FINGERS AND TOES.

Amputation of the fingers may be necessary on account of traumatism, necrosis, gangrene, ulceration, or deformity.

In amputating a finger it is always desirable to save as much of the member as possible, and this is especially true of the thumb and the index finger. It is well to remember during operations upon fingers that the prominence caused by flexing a finger is the head of the proximal phalanx. A knowledge of the relations of a joint to the creases on the palmar surface of the finger will greatly facilitate an amputation at that joint. The distal crease on the palmar surface of the fingers is a little above the joint; the middle crease is opposite the middle joint; and the proximal crease nearly three-fourths of an inch below the metacarpo-phalangeal joint. The joints of the finger lie a little below the prominence formed by flexion of the fingers. In a finger amputation above the middle of the middle phalanx the flexor tendon should always be anchored by means of fine silk to the periosteum, otherwise the stump cannot be flexed, and will remain in the extended position. The theca, or tendon-sheath, should be ligated after it has been divided in an amputation, to guard against infection extending up the finger. The flap or flaps should be so arranged that the scar will be free from pressure while the patient is using his hand. Bones undergoing necrosis should be removed at a joint, and not in their continuity.

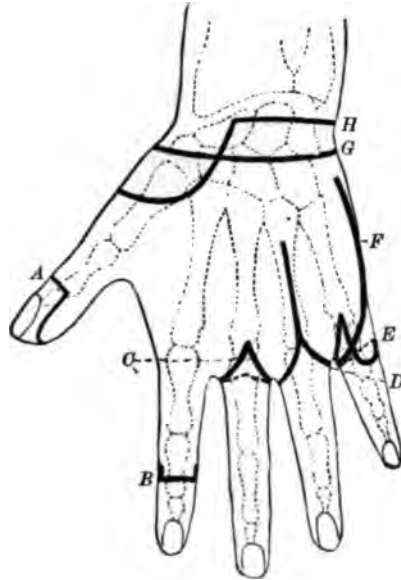
In a working-man avoid, if possible, cutting off the head of the metacarpal bone, as it weakens the hand. Close the wound with as few stitches as possible, and have sufficient space between them for free drainage. Most of the bad results seen after amputation of the fingers are due to an excessive number of stitches in the flaps and failure to close the theca and anchor the flexor tendon.

**Amputation of the Distal Phalanx** (Fig. 277, A).—One simple method which has stood the test of time for removing the distal phalanx is as follows: the patient's hand is pronated, and the fingers which are not concerned in the operation are flexed. The operator places the palmar surface of his left index finger under the distal phalanx and his thumb rests upon the nail of the finger to be operated upon. By pressing with his thumb the phalanx is strongly flexed, and a semilunar incision is made across the finger, its convexity passing a



quarter of an inch below the prominence caused by the flexion; the soft parts are pushed back and the joint is opened; the lateral liga-

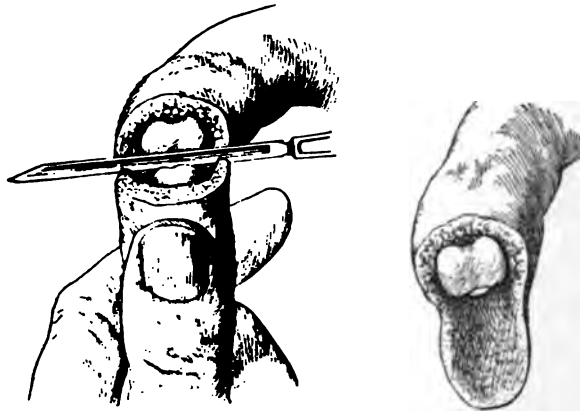
FIG. 277.



*A*, disarticulation of phalanx: palmar flap, *B*, amputation in continuity by a circular flap. *C*, metacarpo-phalangeal disarticulation. *D*, amputation of metacarpal bone in continuity. *E*, disarticulation of little finger. *F*, disarticulation of fifth metacarpal bone. *G*, amputation at the wrist, circular. *H*, amputation at the wrist, lateral. (Stimson.)

ments are cut from within outward; traction is made on the phalanx, and, the joint being well opened, the knife is introduced between the

FIG. 278.



Amputation of a finger by the long palmar flap. (After Esmarch.)

bones (Fig. 278), and a long palmar flap is made by keeping the knife close to the under surface of the bone and cutting downward toward



the tip of the finger. If for any reason the flap just made is insufficient, the head of the second phalanx must be removed. Sutures are required, and the palmar flap is sewed in place with stitches.

**Disarticulation of the Middle Phalanx.**—Disarticulation of the middle, or second, phalanx may be accomplished by a method similar to the one employed in removing the distal phalanx. The flap should be long enough to cover loosely the head of the proximal phalanx. Ligatures will be necessary, and the theca must be cut, and the flexor tendon anchored to the periosteum or sewed to the flaps. Few stitches should be employed to approximate the flaps as to favor drainage between them.

**Amputation of the Middle Phalanx in its Continuity.**—If possible, it is best to amputate this phalanx a little below its base, and when the bone is to be saved a long palmar and a short dorsal flap should be made; some operators, however, prefer a circular flap. After the bone has been sawed the theca should be ligated, and the flexor tendon stitched to the periosteum or fastened in place. Dr. Tiffany, of Baltimore, removes this phalanx at the joint, and after sewing the flaps passes sutures through the flexor tendon sheath. He says good motion can be secured by an anastomosis done in this manner. When in amputation of the fingers a middle of the middle phalanx it is impossible to fix the tendon to the flap or to the periosteum, it is best to amputate at the carpo-phalangeal articulation.

**Amputation of the Proximal Phalanx in its Continuity.**—If the flexor tendon can be anchored, this bone in suitable cases may be sawed through rather than disarticulated at the metacarpo-phalangeal joint, as the stump will be serviceable as an opponent to the distal phalanx. This procedure is similar to the one employed in amputating the middle phalanx in its continuity.

**Disarticulation of the Proximal Phalanx at the Metacarpo-phalangeal Joint.**—This is the most common amputation done in the hand, and is best performed by the oval or "racket" method. The hand is held in pronation, and the radial and the ulnar arteries are compressed above the wrist; the incision is started a little above the head of the metacarpal bone, and is carried down in the line to beyond the base of the phalanx; the knife is then carried obliquely downward on one side and swept across the palmar surface of the finger to the other side at the level of the web; it is then carried obliquely upward to meet the longitudinal cut on the other side (Fig. 277, C). These incisions are at first made through the superficial fascia. The deeper structures are then divided, and the bone, the joint is opened from below, and disarticulation is

(Fig. 279). If it is necessary to remove a part or all of the metacarpal bone, free access can be obtained by enlarging the dorsal incision.

**Removal of the Head of the Metacarpal Bone after Disarticulation of a Finger.**—If it is necessary to remove the head of a metacarpal bone after the finger has been taken off at the joint, free access to the bone may be gained by extending the dorsal incision upward (Fig. 277, *D*). The bone is freed from the surrounding tissue by means of a knife, a two-tailed retractor is adjusted, and the head is removed with a pair of cutting-forceps (Fig. 280).

FIG. 279.



Racket-shaped incision for amputation of the finger at the metacarpo-phalangeal joint. (After Rotter.)

**Amputation of a Finger and its Metacarpal Bone in Continuity.**—The incisions for the removal of a finger and a portion of its metacarpal bone are the same as for disarticulation of a finger at the metacarpo-phalangeal joint; the one on the dorsum being extended backward to a point a little above the point at which the bone is to be divided (Fig. 277, *D*). The tissue is carefully separated from the bone by means of a knife and dissector. The neighboring fingers are then forcibly drawn aside; the lower end of the bone is lifted out of the wound with bone-forceps, a two-tailed retractor is adjusted, and the bone is sawed with a chain-saw or cut with bone-pliers, and the fragment of the bone with the finger is removed.

**Removal of a Finger with its Metacarpal Bone.**—This operation can be performed by the "racket" incision, and the steps are

similar to those employed in removing the metacarpal bone in its continuity, though in this operation the dorsal incision extends to a point one-quarter of an inch above the carpo-metacarpal articulation. The tendons are drawn aside and the tissue is separated from the bone above and at the sides by means of a blunt dissector. The finger is then disarticulated at the metacarpo-phalangeal joint, the lower end of the bone is freed and held up with a pair of bone-forceps, while the soft parts are dissected from the palmar surface up to the

FIG. 280.



Removal of the head of a metacarpal bone. (Skey.)

carpo-metacarpal joint. The ligaments are then incised and the bone removed. In doing this operation care should be taken not to injure important structures in the palm of the hand, and this is safely accomplished by keeping the dissecting instrument close to the bone.

**Amputation of the Toes.**—Caries, necrosis, deformities, traumas, and, occasionally, gangrene may necessitate the amputation of the toes.

Partial amputation of the four smaller toes is rarely performed, as the stump after such an operation is of little use and is very liable to project upward and to be irritated by the shoe, causing great discomfort. Disarticulation of a toe is easily accomplished if it is remembered that the web between the toes lies some distance below the metatarso-phalangeal joint (Fig. 281). In this operation the incision should be so made that the resulting scar will be on the dorsal surface of the toe or foot, and if for any reason it is deemed

advisable to do a partial amputation of one of the smaller toes, the flap should be taken from the plantar surface, the procedure being similar to that of removal of the distal phalanx of a finger. Generally speaking, the great toe is the only one in which a partial amputation is performed.

**Disarticulation of a Toe at the Metatarso-phalangeal Joint.**—A toe can be removed at the metatarso-phalangeal joint by the “racket-shaped” incision (Fig. 281). The incision is begun on the dorsal surface of the metatarso-phalangeal joint, two-thirds of an inch above the articulation, the adjoining toes being forcibly drawn aside; it is carried obliquely downward and forward to one side of the toe, then transversely over the plantar surface of the web, and finally obliquely upward and backward to meet the dorsal incision opposite the point where the oval part of the incision commenced.

FIG. 281.



**Disarticulation of Two Adjoining Toes.**—Two adjoining toes can be removed at the metatarso-phalangeal joints, and the denuded

FIG. 282.



Amputation of the toes and metatarsal bones. (Stimson.)

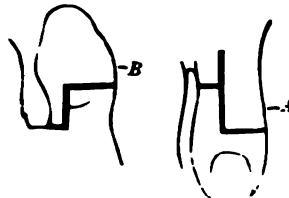
surface covered by a single flap in the following manner: an incision is made from a little above the joint-line over the middle of the interosseous space of the toes to be removed, obliquely downward and forward on the outer side of one of the toes to the digito-plantar fold, then across this fold on the plantar surface of both toes, and obliquely upward and backward on the inner side of the other toe to meet the dorsal incision (Fig. 282). The first incision divides the skin and superficial fascia, and the next exposes the bones and the joints. Each toe is then removed separately after the section of the tendons and ligaments has been performed.

**Disarticulation of the Great Toe at the Metatarso-phalangeal Joint.**—The great toe can be removed at the metatarso-phalangeal joint by the “racket” incision, and the procedure is like that employed in the removal of one of the smaller toes at the same joint. This method is described under Disarticulation of a Toe at the Metatarso-phalangeal Joint.



This operation may also be done by arranging the incision so that a large internal flap will be made. In case the internal flap is to be used, the incision starts on the dorsum of the great toe a little below the metatarso-phalangeal joint, along the outer border of the extensor tendon, and extends to the head of the first phalanx. A transverse incision now runs from the lower extremity of this incision around the inner side of the toe and terminates at the border of the flexor tendon, and from the end of this incision another one is carried

FIG. 283.



Amputation of the great toe.

along from the outer border of the flexor tendon to just below the metatarso-phalangeal articulation (Fig. 283), and is then directed upward over the outer surface of the toe to meet the incision on the dorsum near its centre. The incision at first penetrates the skin and superficial fascia, and then the deeper structures are divided and a large internal flap is lifted.

After the tendons and ligaments are divided the knife enters the joint and the remaining tissues are cut from within outward. The extensor tendon is pulled down and divided high up, the part is cleared of tissue-fragments, the vessels ligated, and the wound closed with a few stitches.

**Removal of a Toe and a Portion of its Metatarsal Bone.**—The incisions for this operation are the same as for the removal at the metatarso-phalangeal joint, the incision on the dorsum being extended upward three-fourths of an inch beyond the point where the bone is to be divided (Fig. 282, C). The adjoining toe or toes being drawn aside, the metatarso-phalangeal joint and the lower extremity of the metatarsal bone are freed from surrounding tissue, and the bone is held up and out of the wound by means of a pair of bone-forceps. The tissue is then separated from this bone up to where it is to be divided. A two-tailed retractor is used to protect the soft parts, and the bone is divided with a chain-saw or a pair of cutting-forceps, and the fragment, with the toe, is removed. This operation can be done by first disarticulating at the metatarso-phalangeal joint and then removing the part of the bone by the procedure described above.

**Removal of a Toe with its Metatarsal Bone.**—This operation is sometimes called for, and can be done as follows: an incision starts on the dorsum one inch above the tarso-metatarsal articulation of the bone to be removed. It extends down to the metatarso-phalangeal joint, then passes obliquely downward and forward on one side of the toe, crosses the plantar surface of the web, and then runs obliquely upward and backward to meet the dorsal incision. The tissue is then separated from the bone and disarticulation at the meta-

tarso-phalangeal joint is effected. The head of the metatarsal bone is held up with a pair of bone-forceps, and by means of a knife the tissue is dissected from the bone up to the tarso-metatarsal joint. The bone is then rotated and the ligaments severed.

### GENERAL ANÆSTHETICS IN MINOR SURGERY.<sup>1</sup>

For certain reasons it may be necessary to administer a general anæsthetic before the performance of even a trivial operation, and in such cases the same precautions are observed as in major operations.

Respiratory and cardiac stimulants, a tongue-forceps, a mouth-gag, a pair of hæmostatic forceps, a number of gauze sponges, and a tank of oxygen should be on a table near the patient. Many of the accidents which happen during anæsthesia occur during diagnostic examinations and trivial operations. A violent peripheral irritation, such as is induced while the sphincter ani is being stretched, in a partially anæsthetized patient, is capable of causing cardiac or respiratory failure. The same is true in operations which involve nerve-filaments; for this reason the reflexes should be abolished by the anæsthetic before any manipulation is employed. Incomplete anæsthesia during operations is a condition of greater danger than complete anæsthesia (Da Costa).

**Primary Anæsthesia.**—When an operation, such as opening a felon or an abscess, can be done in less time than a half a minute primary anæsthesia may be used. It is induced by ether rapidly inhaled. The patient should be in the recumbent position, with one arm at the side and the other arm raised vertically. An Allis inhaler is placed over the nose and mouth, and ether is administered rapidly. The patient should count out loud, and when he can no longer count, and the arm drops as if paralyzed, the incision can be painlessly made.

#### ETHYL BROMIDE.

This agent is sometimes used in minor surgery on account of the rapidity with which it acts and the prompt return to consciousness after the administration. Unconsciousness follows its administration in from a half minute to two minutes, and lasts several minutes after its withdrawal. In the Orthopædic Department of the Jefferson Medical College Hospital it is used extensively in making examinations, breaking up adhesions, and correcting slight deformities.

In the above department the method of administering is as fol-

<sup>1</sup> While it is true that this article to some extent overlaps the field covered by that of Dr. Leonard on "Anæsthetics," yet the subject is of such importance that the Editor has thought best to give Dr. Spencer's views as well.

lows : a folded towel is used as an inhaler ; the entire amount to be given ( 1 drachm to a child, and 2 to 4 drachms to an adult ) is poured on the towel, which is held over the nose and mouth so as to exclude air, but to form a cavity for the gas. As soon as unconsciousness is produced the examination or operation is begun, and when completed the towel is removed. Disagreeable after-effects are rarely seen ; but, like all agents which produce unconsciousness, it cannot be considered absolutely safe. The author knows of one death induced by it, the anæsthetic being given by a man experienced in its use.

#### NITROUS OXIDE.

This agent is used extensively by dentists to produce unconsciousness while teeth are being extracted. Some operators resort to its use in minor surgical operations. Where muscular relaxation is desired, as in examining and reducing dislocation and fractures, it should not be used, as it causes rigidity ; for the same reason its use is unsatisfactory in stretching the sphincter ani.

The advantages of nitrous oxide are its safety, rapidity, and absence of disagreeable after-effects ; its disadvantages are the skill required, the special appliance necessary for its administration, and the fact that it does not produce muscular relaxation (*New York Medical Journal*, Aug. 5, 1899). The time for inducing anæsthesia with this agent varies as with other anæsthetics, according to the type of patient ; in most instances, however, from one to three minutes are required. The anæsthesia lasts from thirty to ninety seconds. After the inhaler is removed consciousness returns immediately.

Bryant says that nitrous oxide is the most agreeable and safest anæsthetic in use, and that the death-rate is infinitesimal. If the patient has heart disease, kidney disease, or phthisis, nitrous oxide is a suitable anæsthetic ; but if much degeneration of the vessels or aneurism be present, it is objectionable on account of the high blood-pressure it occasions. A special apparatus is required for the administration of nitrous oxide.

#### NITROUS OXIDE AND OXYGEN.

In certain cases of minor surgery nitrous oxide and oxygen can be given together with gratifying results. F. W. Hewitt has studied the effects produced on the human subject by the administration of nitrous oxide, nitrous oxide and air, and nitrous oxide and oxygen. He claims that the best results are obtained with nitrous oxide when oxygen is given with it, the next best with nitrous oxide and air, and the worst with pure nitrous oxide. The dangers which are liable to arise from the inhalation of pure nitrous oxide are to a great extent prevented if oxygen be given with the nitrous oxide.



Nitrous oxide produces its anæsthetic effect largely by the prevention of the admission of oxygen into the blood, and it sometimes happens that when oxygen is being given with the nitrous oxide the patient cannot be successfully anæsthetized. In giving nitrous oxide and oxygen a regulating apparatus should be used, which will permit the gradual increase of the oxygen according to the condition of the patient. The longer the administration lasts the more oxygen may be given.

### LOCAL ANÆSTHETICS IN MINOR SURGERY.

When a local anæsthetic can be used, it has the following advantages over the general anæsthetics: less time and expense are connected with the operation; fewer assistants are required; remote ill-effects, such as are seen with systemic anæsthetics, are absent; the danger of death upon the operation-table is avoided; and the disagreeable after-effects, such as nausea and vomiting, are prevented. The essential qualities of a good local anæsthetic are reliability in producing anæsthesia, constitutional and local harmlessness, and a capability of being rendered aseptic. From the fact that there are a number of agents recommended to the profession for inducing local anæsthesia, this alone proves that no one of them can be relied upon to fulfil all requirements; but each one has its advocates and adversaries.

#### COLD AS A LOCAL ANÆSTHETIC.

It has long been known that ice and other agents which greatly lower temperature will produce local insensibility when applied to the skin. The effect of cold as an anæsthetic was noticed by John Hunter in 1776, while experimenting upon animals, and was observed in human beings by Larrey while operating upon the wounded after the battle of Eylau. A mixture of salt and cracked ice, a spray of ether, a spray of rhigolene, and a spray of ethyl chloride may be used to produce cold in minor surgery.

Dr. James Arnott, of London, was the first to recommend salt and ice as a means of producing local anæsthesia in minor surgical operations. His method was to add one part of salt to two parts of pounded ice, to place the mixture in a bag made of rubber, cheese-cloth, or muslin, and to hold it firmly upon the part to be operated upon until the skin assumed a white and tallowy appearance, when the incision was made. In 1866 Dr. B. W. Richardson described a method of inducing local anæsthesia by the use of an ethereal spray. Bigelow, of Boston, improved upon the ether spray by the introduction of the rhigolene spray. The above methods are slow and unsatis-



factory. If cold is to be used to produce local anæsthesia, the most efficient and convenient method of applying it is by means of ethyl chloride. This fluid is very volatile, and is best controlled by having it in an air-tight tube. When not in use, a valve covering one end of the tube prevents leakage (Fig. 284). When the valve is pressed

FIG. 284.



upon, the orifice of the tube is opened, and the heat of the hand forces out a fine stream of liquid, which is directed upon the part to be frozen. Rapid evaporation causes intense cold. The nozzle should be held about fifteen inches from the area to be acted upon. When the spray strikes the integument redness almost instantly results, but in a few seconds the part becomes hard and white. This condition indicates local insensibility, and lasts about two minutes. If the action is slow, it can be much hastened by gently blowing upon the part to increase the rapidity of evaporation.

The refrigeration method of local anæsthesia is of limited usefulness, and is recommended only for opening felons and abscesses, removing wens from the scalp and back, and producing a painless area into which a puncture is to be made. It must be borne in mind that sloughing and ulceration of the skin are liable to follow the use of cold.

#### COCAINE AS A LOCAL ANÆSTHETIC IN MINOR SURGERY.

Cocaine was discovered by Mann, in 1859. Its anæsthetic effect upon the eye was demonstrated by Dr. Koller, of Vienna, at the ophthalmological congress held at Heidelberg in September, 1884.

Dr. H. D. Noyes was the first to direct the attention of American practitioners to Koller's results in the use of this drug. Its introduction was one of the greatest triumphs of modern surgery. It limits the use of the systemic anæsthetics in minor surgical operations, and operations of considerable magnitude are sometimes performed with the part under its influence. Cocaine applied to a mucous membrane produces local anæsthesia in from three to five

minutes, and the area remains insensible to pain for from fifteen to twenty minutes. In nose and throat work, the strength of the solution may be from 2 to 20 per cent. More than two-thirds of a grain should not be applied to a mucous membrane at one time. A 1 to 4 per cent. solution is used in the eye and urethra. A 5 per cent. solution is required in rectal and vaginal work. The amount of the cocaine when used in the rectum and vagina must not be over  $\frac{1}{8}$  grain. In removing growths and foreign bodies from the skin and subcutaneous tissue a 1 per cent. solution should be introduced into the skin by means of a hypodermic syringe. If cocaine is injected near a nerve-trunk, the area supplied by the nerve will become insensible to pain (Krogius). If the part to be operated upon can be constricted, larger amounts of cocaine may be used without the danger of systemic effects, as constriction will prevent the entrance of the drug into the circulation, and the free bleeding which occurs after the constriction has been removed will wash out the cocaine before much of it is absorbed. After the operation the constricting band should be loosened gradually, so as to prevent a sudden ingress of the drug.

The repeated use of cocaine in the same patient should be avoided on account of the danger of establishing the cocaine-habit. The drug should be given with the greatest care, especially in operations about the head, neck, face, and urethra, as several deaths and many alarming conditions of syncope, delirium, and paralysis or tetanic fixation of the respiratory muscles have followed its use. Because of its marked depressing effect upon vital organs it should never be given unless the patient is in the recumbent position. The administration of 1 drop of a 1 per cent. solution of trinitrin, given at the first onset of the constitutional effects, and repeated if necessary every five minutes, will entirely prevent any unpleasant effects, as it is a true physiological antidote.

If the surgeon has a case in which he intends to use large amounts of cocaine, it is best to have at hand and ready for use the following agents: a hypodermic and a rectal syringe, a battery, cardiac and respiratory stimulants, oxygen, and a catheter. If the patient becomes very delirious and is in no way depressed, chloral or hyoscine may be given. In any case of cocaine-poisoning, the patient should be catheterized to prevent reabsorption, and should be then treated symptomatically.

#### SCHLEICH'S INFILTRATION METHOD OF LOCAL ANÆSTHESIA.

Liebreich demonstrated that artificial œdema of a part caused by the injection of water into the subcutaneous tissue produces local anæsthesia, which, however, speedily vanishes. Schleich found that

by adding salt, morphine, cocaine, and carbolic acid to the water an anæsthesia is produced which lasts from fifteen to twenty minutes. The anæsthesia induced by this method is due to ischæmia, pressure of the fluid upon the nerves, and the direct action of the cocaine, morphine, and carbolic acid on the nerve-filaments.

Infiltration-anæsthesia is used extensively in minor surgery, and is indicated in major operations in which the use of a systemic anæsthetic is contraindicated. One of three solutions may be employed. Each solution contains the same proportions of salt, water, and carbolic acid ; but the amounts of cocaine and morphine vary according to the sensitiveness of the part and the gravity of the operation. Schleich employs solution No. 1 in operations upon inflamed and hyperæsthetic areas. Its composition is as follows :

Cocainæ hydrochloratis,	20 gm.
Morphinæ hydrochloratis,	.025 gm.
Sodii chloridi,	20 gm.
Aquæ destillat.,	ad. 100 gm.
Sterilize and add $\text{mj}$ of 5 per cent. carbolic acid.	

No. 2 is the solution used in ordinary operations. Its proportions are :

Cocainæ hydrochloratis,	10 gm.
Morphinæ hydrochloratis,	.025 gm.
Sodii chloridi,	20 gm.
Aquæ destillat.,	ad. 100 gm.
Sterilize and add $\text{mj}$ of 5 per cent. carbolic acid.	

No. 3 solution is very mild, and is indicated in slight operations. It contains :

Cocainæ hydrochloratis,	.01 gm.
Morphinæ hydrochloratis,	.005 gm.
Sodii chloridi,	20 gm.
Aquæ destillat.,	100 gm.
Sterilize and add $\text{mj}$ of 5 per cent. carbolic acid.	

Tablets with directions for preparing the three solutions are manufactured by several reliable pharmaceutical manufacturers. When this fluid is injected into the skin, the skin becomes blanched and œdematous, and wheals are rapidly formed. The technique is simple ; the skin should be cleansed with soap and water, alcohol, and bichloride solution (1 : 2000), and the syringe should be boiled. The syringe is filled and the needle introduced obliquely, and its entire length forced into the Malpighian layer (Fig. 285) ; the piston is now pushed and a few drops are forced out ; these drops form a



white wheal which resembles a mosquito-bite, and is anæsthetic. The needle is withdrawn to the margin of the wheal and more fluid is injected, and the process carried on in this manner until the part to be

FIG. 285.



operated upon is covered with wheals (Fig. 286). Van Hook says that fasciæ, muscles, and periosteum can be anæsthetized as well as the skin; and, in fact, all tissues, except inflamed bones, can be rendered anæsthetic by its use. Such operations as herniotomy, ampu-

FIG. 286.



tations, and rib resection have been performed under Schleich's infiltration method of local anæsthesia.

#### EUCAINE HYDROCHLORATE *A* AND *β*.

A few years ago, eucaine *A* was introduced as a substitute for cocaine. It has been extensively used, and has become popular. Its range of usefulness is more extensive than that of cocaine. Cardiac and respiratory depression does not contraindicate its employment. It does not lose its strength when kept in solution, and is not decomposed by boiling. As much as 2 drachms of a 5 per cent. solution have been used without causing symptoms of poisoning. One to two drachms of a 2 per cent. solution will cause in most cases complete anæsthesia in five minutes. The duration of the anæsthesia varies from fifteen minutes to one hour. The use of eucaine is occasionally followed by tissue-necrosis, particularly if used where there



are terminal bloodvessels, as in operations upon the fingers, toes, or prepuce. It sometimes acts badly in fatty tissue, bursæ, and tendon-sheaths. Coplin has found that by injecting eucaïne *A* into the mesentery of a frog he was able to produce dilatation and congestion of the mesenteric vessels. From this, it might be concluded that it is the mechanical tearing and contusing of the congested capillaries during the operation, by such instruments as the curette and dissector, that causes the sloughing. This conclusion seems more plausible after examination into the many cases in which eucaïne *A* and clean cutting were employed, and the operations were very successful. Eucaïnized tissue will not permit rigid curetting, as a slough is very liable to follow. However, a slough is very liable to follow the rough curettement of eucaïnized tissue.

As a local anæsthetic, it is claimed that eucaïne  $\beta$  retains all the advantages possessed by the preparation called eucaïne *A*, and at the same time it is less toxic, more prompt in action, and is also less irritating. Eucaïne  $\beta$  is employed in solutions of 2 per cent., which are sterilized by boiling.

## CEREBRAL CONCUSSION AND SHOCK.

By JOSEPH RANSOHOFF, M. D., F. R. C. S., Eng.

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### CEREBRAL CONCUSSION.

A CERTAIN number of the many and varied symptoms which follow injuries of the head of greater or less severity often group themselves together to constitute the clinical picture of cerebral concussion. As a bedside feature it was first accurately described by Borel in 1677. However imperfectly understood the pathological conditions underlying the symptoms may be, and however hypothetical the explanations advanced of their mechanism, there can be no question that from a clinical standpoint cerebral concussion or shock, *commotio cerebri*, exists as an entity. The force producing it, as a rule, is applied to or distributed over a large area, as by impact with blunt objects or by falls. Without damaging the cranium it may spend itself on the cranial contents. Therefore the subsequent gravity of the trauma bears no invariable relation to the extent of the primary shock. In the very gravest cases the shock may be entirely absent. *Commotio cerebri* is due to a tearing of the connections between the gray and white matter of the brain, which in most cases is complicated by capillary apoplexies. The lesions are favored by the different specific gravities and the different stabilities of the blood and of the gray and white matter of the brain. Because of their weight the blood and white matter of the brain, when set in motion, possess more energy than the gray matter and the cerebrospinal fluid. There results a tearing between the white and the gray matter as stated, and there is also a rupture of the capillaries due to the impact of the blood against their walls.

Depressed fractures of the skull and penetrating wounds are often associated with less shock than are seemingly more trivial injuries in which the brain as a whole is primarily involved. Quite recently I saw two illustrative cases—one with Dr. Jenkins of Newport, the other with Dr. Berry of Fairmount. The first was that of a boy seventeen years of age who had been struck with a cleaver: over the left frontal region there was an incised and depressed fracture of the skull with penetration of the dura. There was not even momentary concussion, the boy starting on a two-mile walk immediately after the injury was inflicted. The second was a pistol-shot wound of the skull

which penetrated the left frontal lobe, producing paraphasia. The skull was fractured, the dura perforated, the brain-substance oozing from the wound when the trephine was applied; yet there was no concussion.

Among the accidents followed by brain-shock, falls take a foremost place. The height need not be very great; often it is only a few feet, the momentum at the instant of impact being of greater importance than the distance. If great mental perturbation, as from fright, has preceded the fall, the effects of the concussion appear accentuated. Indeed, it is probable that the emotion mentioned is capable of producing the clinical manifestations of cerebral shock without physical influences of any kind. During the Cincinnati riots of 1884, I was called to see a gentleman with a gunshot injury of the hip. When I arrived on the scene I found a man pale, bathed in perspiration, pulse scarcely perceptible, and muttering incoherently. I believed him to be the seriously injured one, yet he had not been touched. The firing of the musketry had shocked him more than had the gunshot injury the companion with whom he had been walking.

The effects of the combined influences of the psychical and physical causes of shock are well illustrated by cases in which individuals are thrown from horses or vehicles. Here the symptoms are more pronounced than in cases in which the sensorium was unruffled at the moment the shock was sustained. The fact accepted by clinicians that individuals under the influence of alcohol are less liable to concussion from injury, other things being equal, corroborates the idea intended to be conveyed.

Except in very rare cases the force producing cerebral concussion is applied to the head, and generally the symptoms are commensurate with the degree of the violence. Sometimes, however, such trivial forces as a blow from a fist or butting against an object in the dark are followed by alarming symptoms of concussion. Occasionally cases are recorded in which even a fatal shock is indirectly produced by falls on the buttocks, the feet, or the knees, the force being transmitted the length of spine, the cranium and its contents presenting no discernible lesions. Such cases should always be carefully scrutinized, for in most of them the autopsy will reveal the presence of extensive intra-abdominal or thoracic damage not recognized during life.

**Symptoms.**—Presuming for the moment that cerebral concussion is the effect of vibrations imparted by the cranium to the brain, including the medulla, as a whole, it is evident that the symptoms which may be said to be typical of it must vary in degree within very wide limits, even in pure cases, and that very often the clinical picture is changed or entirely effaced by the development of secondary and generally greater intracranial lesions. The rapidity with which this effacement sometimes ensues has led to the belief that concussion is



not at all present in some injuries which diffusely affect the brain and are rapidly fatal, such as fracture of the base. Yet symptoms of shock are probably always present, though they may be of such short duration that they are not seen by the surgeon.

In 1881, I saw a girl of fourteen fall from a second-story window to the pavement. Within a minute I was at her side. There was absolute unconsciousness; pulse feeble and flickering; respirations shallow; pupils contracted; face of deathly pallor. Within ten minutes reaction had set in; the pulse became full and slow, color returned to the face and warmth to the body. Then a bluish spot appeared over the left eyelid; it extended to the conjunctiva, and became deeper in color with each minute. Respiration became stertorous; the pupils, which had been contracted, were now dilated. The symptoms of compression from basal fracture had supplanted those of concussion. The girl died on the fourth day. The autopsy made by Dr. Zinke revealed a very extensive basal fracture. "The brain itself betrayed no sign of injury or disease, so far as could be determined by macroscopic inspection." The symptoms of concussion were clear until hæmorrhage sufficient to produce compression had taken place.

Following the lead of Dupuytren, most systematic writers classify cases of cerebral concussion according to their severity into the mild, the grave, and the gravest. Such a division is warranted only in the most general way. Hard and fast lines cannot be drawn, since apparently trivial cases may prove fatal through their sequelæ, and cases primarily grave are often followed by surprisingly speedy and complete recovery.

The chief symptom of cerebral concussion is found in perturbation or complete abeyance of consciousness. In the mildest cases, such as follow a light blow on the forehead, it is momentary: the individual does not even fall. There is slight giddiness, and loss of vision, with or without flashes of light before the eyes. Rushing noises may be heard; there is slight bewilderment; a few incoherent words may be uttered, and the mental equilibrium is again restored. In somewhat severer cases the impairment of the sensorium is more prolonged and profound, and there are evidences of involvement of the cardiac and respiratory centres as well as of the gray matter of the cortex. The pulse is small, felt with difficulty, and usually reduced to fifty or sixty beats per minute. In accord with this lowered tone of the circulation are the blanched face and lips. Respirations are shallow and decreased in number. Often they are irregular and sighing. The muscular system is thoroughly relaxed, and the patient lies in the position in which he has fallen. The loss of consciousness is not complete. By rousing the patient, incoherent, usually monosyllabic, answers can be obtained. This condition may last from a few minutes to an hour or two, or even longer,



when recovery ensues, often with great rapidity. The regularity of respiration is re-established; the pulse increases in volume and frequency; the color returns to the face and consciousness is restored. A tottering gait often characterizes the first effort at walking, and severe headache may be complained of.

In concussions of slighter degree the entire picture may pass off in less than an hour and the patient resume his usual vocation. In very exceptional cases motor disturbances supervene toward the end. Twitching of the ocular and facial muscles is observed. In one instance I saw a general epileptiform seizure occur in the ordinary course of a concussion. The patient, a very healthy adult, in avoiding a passing vehicle slipped and fell, the occiput striking the curb. The usual symptoms of concussion, which had lasted for an hour, were followed by a general convulsion of several minutes' duration. When he came out of this the patient roused himself and insisted on walking to his home several miles away. He had no other convulsions, nor has he since experienced any ill effects from the accident sustained four years ago.

Not so fortunate always is the end of even mild cases of cerebral shock. In not a few disturbances of articulation, paraphasia, stammering, facial or ocular paralysis, follow and may continue for many months. The intellect is weaker, and the capacity for work is often greatly diminished. There is sleeplessness and loss in body-weight. Diabetes insipidus and mellitus often follow, and although they are generally transitory, like glycosuria physiologically produced, they may continue for years. Such a case I saw recently. The urine had remained saccharine for three years following concussion sustained in a railway accident. The scalp was cut by a piece of glass. A month before the injury was inflicted the patient was examined for life insurance by several physicians, who found the urine normal.

In the graver forms of cerebral concussion, as in those above described, the loss of consciousness immediately follows the accident. Without a cry the patient sinks to the ground completely relaxed; the feeble pulse and shallow respirations are the only evidences of life; the loss of consciousness is complete, for neither through the special senses nor by cutaneous irritation is it possible to obtain a reflex contraction. Boyer cites the case of a woman who gave birth to a child while suffering from cerebral shock. When she awoke from her lethargy she was ignorant of what had occurred. In such grave cases the face is of a deathly pallor and bathed in clammy sweat. The body-temperature is lowered two, or even three, degrees. The pupils are generally unevenly contracted, but at all events sluggish to react. Urine and feces are voided involuntarily. Sometimes there is vesical retention. If the injury was sustained after the ingestion of a full meal, free emesis

may indicate beginning reaction. Deglutition is performed easily when food is introduced beyond the mouth. According to Gross, bleeding from the nose is not an uncommon symptom in severe cases, and hæmorrhage from the ear may occur without basal fracture.

It is characteristic of the symptoms of concussion of every degree of severity that they are most pronounced immediately after the accident, and that the general tendency is toward amelioration. Although, as will be seen later, many of the symptoms detailed are produced by recognizable lesions, and are therefore not the result of concussion alone, it may be considered certain that any exacerbation of them is invariably the result of some additional complicating factor, such as contusion, hæmorrhage, or inflammatory exudation. So in grave cases the unconsciousness, muscular relaxation, or depression of cardiac and respiratory centres may last for several hours, and even days, when, if complications do not ensue, the progress toward recovery is made manifest. The sopor becomes less profound, and one is enabled to get some response. Occasional voluntary movements of the extremities are made, and by signs the patient expresses his desire to void urine or feces. Pulse and respiration become normal, and often the former surpasses the normal limit both as to frequency and fulness. More and more easily the patient can be roused from his lethargy. Answers are more readily obtained and become more rational. Gradually the mental hebetude disappears, and restitution to the normal ensues in from one to ten days, according to the gravity of the case.

Whenever the clinical history is protracted beyond a few days it is probable that the symptoms of concussion have made way for those of coarser lesions. Abernethy, with his usual clinical acumen, divided the symptoms of concussion into three periods. The first is characterized by unconsciousness; the second, by return of intelligence; and the third, by return to health. There are yet other cases of cerebral concussion in which the shock to the cardiac and respiratory centres is so violent that death is almost instantaneous or follows in from several minutes to an hour or two, consciousness never returning. The researches of Prescott Hewitt and others have shown that such cases are much rarer than was formerly supposed, and that in the great majority of cases presumed to be of this nature there are gross lesions, such as contusion or laceration of the brain, hæmorrhages into the spinal canal which are readily overlooked, or fatal visceral lesions like cardiac rupture or laceration of abdominal organs. Nevertheless, medico-legal inquiry every now and then reveals death from cerebral concussion alone.

The following is a case that came under my observation, Dr. Kebler making the judicial autopsy: A man of forty years, who was a moderate drinker, but of excellent health, to escape the heat of a crowded tene-



ment left his room toward morning to seek rest on a lumber-pile eight or ten feet high. Several hours later he was found dead on the ground, evidently having fallen from his improvised couch while asleep. The autopsy revealed nothing but a contusion of the scalp which extended to the pericranium. There was no fracture, nor was there any bruising of the cerebral cortex. The vessels of the pia appeared greatly dilated, the puncta vasculosa seemed larger than normal, and the bleeding from the divided dural sinuses seemed more copious. It is probable that the dependent position in which the head was found, and had remained after the accident, to no inconsiderable extent was accountable for the increased vascularity of the brain and meninges. Nothing was found in the thoracic or abdominal organs to account for death.

Bergmann also reports two cases judicially investigated, and for the thoroughness of the autopsies he vouches: A boy of two years, in perfect health, was put to bed by his mother. Half an hour later he was found dead on the floor. On the forehead and on the vertex were found two contusions three-fourths of an inch in diameter. Neither in the meninges nor in the brain were any changes discernible, with the exception of marked injection of the vessels of the pia, the choroid plexuses, and the serous lining of the ventricles. The latter contained half an ounce of serum; the sinuses, fluid blood. The other organs were normal. A peasant-youth aged fourteen was found on the roadside near a sleigh which he had been seen driving several hours before. He had been in perfect health. The official investigation revealed two semicircular excoriations nearly two inches long and half an inch wide—one below the right orbit, the other on the left side of the lower jaw. Beneath the latter blood-extravasation extended to the bone; beneath the former, only through the subcutaneous cellular tissue. There were smaller superficial suggillations in the right temporal region, over the sternum, and about the legs. On the deep surface of the scalp, at a point corresponding to the right frontal eminence, were two extravasations as large as a dime. The integument was unbroken. The dura was tense, the vessels were injected, and the sinuses distended. The cerebral convolutions were flattened, rather soft in consistence, and contained within many puncta vasculosa. The vessels of the ventricular walls were strikingly distended. Each of the lateral ventricles contained an ounce of reddish serum. With the exception of hyperæmia of the lungs nothing noteworthy was found in the other organs.

In each of these cases death resulted from head injury in healthy individuals. Yet no marked lesions were found, unless the injection of the vessels of the pia and the presence of reddish serum in the ventricles be so considered. The degree of injection is always relative. It is found in cases in which the cause of death is far removed from

the cranium. It may result from dependence of the head after death. To consider it a "lesion of cerebral shock" does not seem warranted. Therefore it seems certain that death can result from concussion uncomplicated by what must be regarded its more common causes—contusion, laceration, or exudations hæmorrhagic or inflammatory in nature.

The possibility of a fatal issue to brain-shock appears of paramount medico-legal importance, in view of the tendency of recent writers to call it in question. The view expressed is substantiated by the fact that cerebral embolism is often attended with some of the symptoms of brain-shock, although the circulation of only a limited area is temporarily involved.

**Differential Diagnosis.**—The symptoms of cerebral concussion are often followed by or blended with those of other conditions, from which it should be distinguished. Particularly important is the diagnosis between concussion and compression of traumatic origin. The one *per se* never requires surgical interference; the other is often amenable to it. Indeed, every case of compression in the light of modern surgery suggests the possibility of relief by operation. While concussion lasts operations are generally contraindicated. For this reason I deem it wise to adopt parallel columns to bring into prominence the chief points in differential diagnosis, and to make use of Agnew's table as modified by Corley:

CONCUSSION.	COMPRESSION.
Unconsciousness is incomplete; patient can be made to answer, though it may be briefly and in simple words.	Complete unconsciousness; may scream into patient's ear at the top of the voice, but will receive no answer.
Special senses, though greatly blunted, are not abolished.	Special senses entirely suspended.
Power of movement not destroyed; if the position of a limb be changed, the patient will resist or bring it immediately into the original position.	Complete or partial paralysis; in most cases hemiplegia.

The compression in this table is that which is general and affects the brain as a whole. Such compression might result from a subdural clot or extensive basal effusion. There is in addition the more limited lesion, which, without at any time having produced symptoms of general compression, or if so after these have subsided, makes itself manifest by monoplegia or monospasm. Such a case presented itself in the surgical ward of the Cincinnati Hospital several years ago: A robust adult was struck with a shovel on the right side of the head. He sank to the ground in collapse. When brought to the ward reaction had taken place. He was in a condition of sopor, from which he could be roused. Some incoherent muttering was noted. Pressure



over the right parietal eminence was painful and elicited a cry. There was very marked paresis of the lower portion of the left side of the face. No fracture could be detected. Urine had to be removed with a catheter. The patient continued in this condition for four days, when a gradual improvement in the mental condition was noticed. In two weeks the facial palsy had also disappeared, and the patient was discharged well. Here there were added to the symptoms of concussion those of localized cerebral compression from hæmorrhage into or on the surface of the cerebral convolutions. The chronological sequence of symptoms from shortly after the onset to recovery is satisfactorily accounted for in this manner, the reasoning being justified by what is known of the absorption of blood-clots in other parts and tissues of the body.

In another class of cases the symptoms of compression do not follow until the patient has almost or entirely recovered from the concussion. They are cases which often bring uncalled-for censure on resident hospital surgeons. An individual receives a fall or blow on the head. The symptoms of shock disappear after a few hours. The patient is dismissed from observation, often at his own request. Several hours later he may be returned to the hospital with all the evidences of compression from a hæmorrhage from a ruptured middle meningeal or other artery. Here the differential diagnosis is established by the presence of an interval of lucidity in the clinical history—an interval which may vary in length from several minutes to eight days.

#### CEREBRAL IRRITATION.

Among cases of concussion and contusion one will occasionally be encountered in which, after a partial return to consciousness and normal cerebration, convalescence is arrested, the patient presenting a characteristic mental and physical condition. Though observed by older writers, Erichsen was the first to direct special attention to it and give it the name of cerebral irritation. His description so perfectly portrays what I have seen a number of times that I present it in full: "The attitude of the patient is peculiar and most characteristic: he lies on the side and is curled up in a state of general flexion. The body is bent forward, the knees are drawn up on the abdomen, the legs bent, the arms flexed, and the hands drawn in. He does not lie motionless, but is restless, and often when irritated tosses himself about. But, however restless he may be, he never stretches himself out nor assumes the supine position, but invariably reverts to the attitude of flexion. The eyelids are firmly closed, and he resists violently every effort to open them. If this be effected the pupils will be found contracted. The surface is pale and cool, or even cold. There is no heat of head. The pulse is small, feeble, and slow, seldom over seventy.

The sphincters are not usually affected, and the patient will pass urine when the bladder requires to be emptied. There may, however, though rarely, be retention. The mental state is equally peculiar. Irritability of mind is the prevailing characteristic. The patient is unconscious, taking no heed of what passes unless called to in a loud tone of voice, when he shows signs of irritability of temper, or frowns, turns away hastily, mutters indistinctly, and grinds his teeth. It appears as if the temper as much as or more than the intellect were affected in this condition. He sleeps without stertor."

The recovery which follows is usually tedious; many days and weeks, even months, may pass before the mental equilibrium is restored. In not a few cases entire recovery never ensues, evidences of mental weakness continuing throughout life. Peculiarities which existed before the accident are accentuated. Sometimes cerebral irritation is followed by temporary or even permanent insanity. In the case of a young girl of eighteen whom I saw in Longview Asylum for the Insane melancholia followed this condition. The cerebral irritation followed the concussion produced by a blow on the temple from a mallet. The concussion was very mild, but the symptoms of irritation were marked for nearly four weeks. A period of mental fatuity followed. It was only after the patient began to walk about that the signs of the psychosis were marked. She remained in the asylum about six months, when she was discharged cured. More than a year has passed since, but there has been no recurrence of her symptoms.

Injuries of the head are not infrequently followed by mental impairment without the intervention of cerebral irritation. The degree of mental disease is not commensurate to the severity of the injury. Simple concussion is as often causative of insanity as fracture. According to Kraft-Ebbing, such cases of insanity may be divided into three groups: 1. The psychosis is the direct result of the trauma. The patient becomes weak-minded, even imbecile. Frequently there follow disturbances of co-ordination, or paralysis. The anatomical change found in these cases is a molecular degeneration of the cortical cells following inflammation of the cortex and the meninges. 2. The psychosis is preceded by prodromata affecting chiefly the sensibility. There is marked excitability: the patient is moody, and a change is noted in his character. Maniacal attacks often supervene, and are followed in turn by progressive paralysis with total loss of mentality. The causative importance of cranial injuries in relation to progressive paralysis of the insane is apparent from the tabulation of 76 cases by Meyer, in 15 of which trauma is given as the immediate cause. 3. In this class of cases the injury must be considered as a predisposing influence toward insanity, in that the latter does not develop until one of



its more common causes is inflicted on a cortex impaired in nutrition by a trauma.

Another condition, at times difficult to distinguish from concussion with or without contusion, is traumatic inflammation of the brain and its meninges which often speedily follows the shock. In the light of the now generally accepted views of the causes of inflammation it is easy to comprehend how this process follows brain-injuries complicated by wounds of the enveloping soft parts or by fracture. In fractures of the base two infections may result through rents in the membrana tympani, the roof of the nose, or pharyngeal vault. When there is suppuration in other parts of the body we can also explain the existence of intracranial suppuration after cranial injuries uncomplicated by external wounds. But in cases of simple concussion a high grade of inflammation, even if it be not suppurative, often follows the shock after a few hours or days. The very great vascularity of the pia after concussion fully accounts for the clinical fact that inflammation so speedily follows the former, at first masking the symptoms, soon to supplant them completely. What appears to be a normal reaction passes into the pathological condition of inflammation.

Several years ago a girl of seventeen years suffered a very severe cerebral concussion in an inclined-plane accident. When I first saw her consciousness was completely lost. The temperature was 96° F., and continued below normal for nearly two days. There was no paralysis, nor were there any convulsions, general or local, to indicate contusion. Other injuries sustained were a simple fracture of the leg, a very slight cut at the angle of the mouth, and another of the eyebrow. The symptoms of shock continued during two days, when reaction came on. Consciousness did not return with it. The temperature was normal for only a few hours, but rose rapidly to 101° or 102° F. in the morning and 103° or 104° F. in the evening. The pulse became hard and very rapid, the face flushed. The patient, who during forty-eight hours after the injury was quiet, with muscles relaxed, became restless in the extreme. It was difficult to fix the fractured limb. While concussion lasted not a word escaped her; now she was sleepless, at times wildly delirious and difficult to restrain. Vesical incontinence, present during the first days, gave way to retention, which made catheterization indispensable for weeks. The tongue became coated, the bowels constipated and moved only by active purgatives. Although the inflammatory process involved a large cerebral surface, nothing of a localized nature developed. Under the use of the continuous ice-douche, blisters to the nucha, active purgation, and enough opium to quiet her, complete recovery ensued.

The rapidity with which the concussion in this case was followed by inflammation, and the intensity of the symptoms from the start, are



not unusual. In many cases, however, from three to five or more days elapse before this sequel makes itself manifest. The longer the interval of quiescence the more insidious in its onset is the inflammatory process. The patient may have believed himself entirely recovered from his injury for a number of days, possibly weeks. Then he feels a general malaise; he has headache and is restless at night. Possibly dreams disturb his sleep. There may be vertigo and some vomiting. He is forced to take to his bed. Rapid pulse, elevated temperature, and delirium follow. The complete picture of traumatic cerebral inflammation is *en scene*, and is shifted through the various phases of paralysis, convulsions, and coma until death comes.

**SHOCK.**—A condition often contrasted with cerebral concussion is that of general concussion or shock following injury to other parts than the head and its contents. It is essentially a reflex paresis of the vascular system, and chiefly of the heart, consequent on a profound and violent impression made on the nervous system. Sudden and destructive injuries causing lacerations of a limb are among the most common causes of shock. But profound mental impressions without physical injury are also at times followed by it. As in cases of cerebral concussion, there is great depression of the vascular system. The temperature is subnormal. The face and extremities are cold, and beads of perspiration cover the skin. The respirations are short and frequent, the pulse rapid and feeble. As in cerebral shock, there is often vomiting attended by fecal incontinence. There are in both great muscular debility and relaxation of the extremities. But the chief clinical feature of cerebral concussion, the insensibility, is absent in cases of general shock. In the latter condition the evidences of life may be feeble in the extreme, the pulse scarcely or not at all perceptible, the respirations irregular; but consciousness is present and cerebration is normal, so far as it is compatible with the enfeebled circulation. The patient may be confused in general shock, but a sharp question will arouse him and bring forth a rational answer. In some cases the intellect appears to be even stimulated, and the mind preternaturally clear. The patient converses rationally to within a few moments of his death. With this cardinal feature of general shock in mind there ought never to be any difficulty in distinguishing it from cerebral concussion.

Among the sequelæ of concussion of considerable medico-legal importance is the impairment of memory. As a rule, in the graver forms the patient cannot recall the manner in which the accident occurred. Frequently the mental pictures antedating the injury by hours, or even days have been entirely obliterated. In a carriage accident recently seen the patient, a young lady, was unable to recall anything that had occurred that day. She did not remember that her carriage had been struck by a locomotive, that she was coming

from church at the time, and that she had a companion in misfortune who had called for her early in the morning and been with her during the service. In not a few cases in which the patient was subsequently enabled to give a detailed account of an accident I have felt certain that it was a recital of what had been learned from hearsay, and not of impressions received at the time. Mental impressions repeated daily and for years may be obliterated by cerebral shock. Medical literature is replete with cases of loss of memory from it. Friends are forgotten. The wife does not remember that she has children or is married. Accomplishments, such as music and the knowledge of languages, are lost; indeed, results of years of education may be swept away and the mind left a *tabula rasa* for new impressions. It is well to bear in mind that, whereas such results are more commonly seen after cerebral concussion, they may also occur after general shock or after recovery from the collapse accompanying severe hæmorrhages.

**Pathology.**—When death follows upon cerebral concussion or any of its sequelæ the anatomical changes found within the cranium will vary according to the degree of violence inflicted and the duration of life afterward. As has already been stated, cases are occasionally encountered in which there are no visible lesions in the brain or meninges, except more or less marked vascularization of the meninges, resulting from paresis of the blood-vessel walls. As a direct result of this the presence of more or less sero-sanguineous fluid will sometimes be observed in the ventricles and subarachnoidean spaces. In yet another class of cases the thin-walled terminal vessels passing through the medullary portions of the brain will have ruptured in many places, leaving minute hæmorrhages distributed through the white substance. They are the miliary apoplexies of Nélaton and Rokitsansky. The presence of a blood-clot, however small, readily permits this condition to be distinguished from mere dilatation of the normal puncta vasculosa. In very many cases of concussion the autopsy reveals numerous extravasations of blood within the cortex or beneath the pia. The brain in these places presents a contused or bruised appearance if death occurred shortly after the accident. After several days or weeks a more grumous appearance is found. Such extravasations occur at a point corresponding to that of impact or to one diametrically opposite. Very often, however, the extravasations are found at remote points. Not all parts of the cortex and pia are alike subject to extravasation. The frontal and spheno-temporal lobes are more frequently involved, and here again the extravasations are found oftener on the inferior than the superior surfaces. The osseous and membranous projections from the floor of the anterior and middle cranial fossæ will explain the more frequent ecchymoses in parts of the brain contiguous to them. The occipital lobe resting on the tentorium



is comparatively safe from severe impact. Without great damage to the brain-substance submeningeal extravasations covering large areas are sometimes seen. As the extravasation takes place the pia is lifted from the underlying cortex, until an entire lobe may present the appearance of a massive blood-coagulum. On stripping off the pia the convolutions may present nothing abnormal except flattening. Death in these cases usually ensues with the symptoms of compression.

Langier believed that the violence of concussion spent itself on the cortex. The implication of the heart and respiratory centres as seen during life militates against this doctrine. It is true that visible lesions in the medulla and pons are not often found; but they do occur: Agnew reports such an instance of extravasation into the medulla oblongata. The prominent symptom was irregular and difficult respiration.

Associated at times with depressed fractures of the vault, or oftener with complicated and extensive lesions of the base, the brain is found lacerated. Extending through the thickness of a convolution or far into the white substance will be found a rent more or less filled with a hæmorrhagic extravasation, and clearly to be seen only when this is removed under a jet of water. In these cases the symptoms of concussion may, as already explained, have been entirely overlooked on account of the rapidity with which they were followed by those indicative of contusion, hæmorrhage, and compression.

The anatomical data obtained in fatal cases of cerebral concussion throw but little light on the method and mechanism of its production. Whether it is the result of molecular vibrations of the cells of the cortex on each other, or of vibration of the brain-mass as a whole within the cranial walls, is at yet unknown. Experiment has been of little or no service in solving this part of the question. The absence of gross lesions in undoubted cases would seem to show that molecular changes are the cause, whereas the contusions more frequently found would indicate that the brain as a whole is violently jolted by or against the firmer structures receiving the brunt of the blow. Stromeyer believed that a temporary compression thus produced would explain the symptoms of concussion, and particularly those cases in which the symptoms rapidly disappeared. This explanation is unsatisfactory, since the long-continuance of symptoms is incompatible with temporary compression. The coma following compression is relieved at once by the removal of the clot which produces it. The view of Fischer, that the symptoms and lesions of brain-shock are the result of paralysis of the vessels of the pia, most satisfactorily accounts for both. Paresis of the arterial walls followed by secondary venous distension produces such diffuse disturbances of nutrition of the cortex and of the cardiac and respiratory centres that their functions are to a very large extent interfered with. The experiments of Koch and



Filehne, in which by repeated light blows they were able to produce symptoms of concussion, and even death, without gross cerebral lesions, go far toward establishing this doctrine of the vaso-motor paralysis as the essential feature of brain shock.

**Treatment.**—The tendency of cerebral concussion is toward recovery. In very many cases its manifestations have passed away before surgical assistance arrives. When seen during the period of depression it is not always wise to interfere actively. The natural desire to combat depressions by active stimulation ought to be resisted. Placing the patient in a horizontal position, loosening the garments to facilitate respiration, the application of dry heat to the extremities, and friction of the skin, will, as a rule, be sufficient to tide the patient over the period of depression. When it becomes apparent that the means named are insufficient, diffusible cardiac stimulants must be administered, but sparingly, lest when reaction ensues it be excessive. The exhibition of stimulants by the mouth is not always feasible. Often the patient cannot be made to swallow, and the presence of fluids in the pharynx becomes an additional source of danger by impeding respiration. Enemata of hot normal salt solution can always be given with little trouble. If the heart's action still remains feeble, hypodermic injections of ether, of a drop of 1 per cent. solution of nitroglycerin, or of camphor—10 per cent. solution in olive oil—may be administered with much benefit. As soon as reaction comes on such medication should cease. The return of color to the face, the awakening to consciousness, or vomiting should put an end to stimulating treatment. In cases in which the unconsciousness from concussion or contusion continues for many hours, the condition of the bladder must be watched. While depression continues the renal secretion is greatly diminished; nevertheless, it is wise to use the catheter to prevent hyperdistension of the bladder.

When reaction has set in the therapeutic indication is to keep it within physiological bounds. Absolute rest of body and mind is to be insisted on, and where the concussion has been severe it is always wise to keep the patient in bed and on a low diet for a number of days, or even weeks. In this connection I deem it wise to point out the necessity of strict aseptic treatment of whatever open wounds the patient may have sustained about the head or other part of the body by the accident. Should symptoms of meningeal inflammation supervene, they are to be met by the continuous ice-douche, leeches, and purgation on general therapeutic principles. For concussion operative interference is not called for. For this reason the surgeon should most carefully watch his patient to detect in their beginning evidences of the many conditions which follow cerebral shock, and which can be relieved only by operative measures.

**SHOCK.**

**SHOCK** may be defined as a relaxation or abolition of the sustaining and controlling influence which the nervous system exercises over the vital organic functions of the body. It is the result of a profound impression made on the cerebro-spinal axis, either directly, through the agency of an afferent nerve, or through the circulatory medium. A blow on the head or a severe fright, the mangling of a limb, and the ingestion of certain violent poisons are equally capable of producing shock, and in each case it is made manifest by more or less depression of the vital processes, notably of that of the circulation. According to the nature of its cause, shock must be considered as a reflex phenomenon or as the immediate effect of a physical or toxic injury to the cerebrum or its large basal ganglia. An overwhelming majority of cases, including those of traumatic and psychic origin, belong to the former category; a small minority to the direct variety.

The causes of shock may be divided into—1. The traumatic; 2. The psychic or emotional; 3. The toxic. In not a few cases a combination of these causes is active in the production of shock.

Osborne would substitute the term medical shock for heart-failure, insisting that it is the counterpart of surgical shock. The condition is primarily a vasomotor paralysis with a congestion of the greater part of the blood in the abdominal veins. The treatment in general is the same as that of surgical shock: the hypodermic use of cardiac and vasomotor remedies; nutrient enemata; or the rectal injection of hot water, salt solution transfusions, etc.

Every trauma, however slight, may be followed by shock. Incised and contused wounds, fractures, subcutaneous or compound, gunshot wounds, burns, scalds, the mangling of limbs, and exposure to extreme cold may be cited as among the most frequent precursors of surgical shock.

As a rule, the severity of shock is proportionate to the extent of the injury. A compound fracture is followed by severer shock than a simple one; the crushing of a limb by greater shock than either. Injuries to the lower extremities are always productive of severer shock than are similar injuries to the upper extremities. Mangling of the upper extremity is generally followed by little shock. The nearer the injury approaches the trunk, the graver is the attendant depression. The opening of large joints and the penetration of the great cavities of the body are among the most fruitful causes of shock that is often rapidly fatal. The method of infliction of the trauma is an important element in determining the degree of shock produced. A fall from a height of twenty feet will be followed by greater shock than one from two or three feet, though in either case the lesion may be but a simple fracture.

The shock observed after railway accidents is greater than that from other injuries, the local damage being the same. As in cases of cerebral concussion, the consciousness that an accident was impending largely influences the degree of the shock which follows it. The soldier in the heat of battle or the brawler in a street-fight does not know that he is wounded until he sees or feels the blood. Quite recently a man was brought into the surgical ward of a hospital with eight feet of intestine hanging from an abdominal wound. The shock was so slight that it required the combined strength of a number of officers to restrain him from pursuing his aggressor. Great dread, on the other hand, accentuates shock. Several years ago a man in robust health was brought into the wards of the Cincinnati Hospital. He had fallen into a bear-pit and had been clawed. The wound was superficial, extending from the shoulder to the wrist. He died in thirty hours from shock. The autopsy revealed absolutely normal viscera.

In illustration of the etiological importance of fear or terror in the production of shock the case reported by Brunton will bear quotation: "Many years ago the janitor of a college had rendered himself in some way obnoxious to the students, and they determined to punish him. They accordingly prepared a block and axe, which they conveyed to a lonely place, and, having dressed themselves in black, some of them prepared to act as judges and sent others of their company to bring him before them. When he saw the preparations that had been made he at first affected to treat the whole thing as a joke, but was solemnly assured by the students that they meant it in real earnest. He was told to prepare for immediate death, for they were going to behead him then and there. The trembling janitor looked all around in the vain hope of seeing some indication that nothing was really meant, but stern looks everywhere met him, and one of the students proceeded to blindfold him. The poor man was made to kneel before the block; the executioner's axe was raised; instead of a sharp edge, a wet towel was brought smartly down on the back of the culprit's neck. This was all that the students meant to do, and, thinking that they had frightened the janitor sufficiently, they undid the bandage which covered his eyes. To their astonishment and horror they found that he was dead."

The violence producing traumatic shock is ordinarily of momentary duration. Comparatively slight injury often repeated may likewise produce it. Death from flogging was not of infrequent occurrence in England a few decades ago. The culprit being tied to a post in a perpendicular position, shock was great. In a case recently witnessed in Siberia the pulse at the end of the operation was 120 and very weak, the temperature 99.5°.

To the purely traumatic causes of shock from the application of



physical force from without must be added those that have their origin within the body. It may follow rupture of an aneurism, the impaction of a renal or biliary calculus, perforation of the stomach or intestine, or the plugging of a cerebral artery.

In cases of burns and scalds the degree of the shock depends more on the extent of skin involved and on the site of the burn than on its depth. Burns of the first degree affecting a large area, particularly of the trunk, are often followed by fatal shock. Such an injury to the genitalia, though limited in area, is also often followed by great shock.

Surgical operations are largely influential in the production of shock. The introduction of a sound into the urethra has been followed by death in a few hours, and the introduction of a needle into a pleura filled with fluid has been followed by immediate death. So has the opening of an abscess of the finger. Prolonged operations attended with considerable loss of blood, the exposure of large wound-surfaces or of serous sacs to the air, are often followed by grave shock. While anæsthesia modifies shock, it does not abate it. As the saw cuts through the bone in an amputation the breathing often becomes stertorous, and there is an acceleration of the pulse as a reflex indication of shock during profound anæsthesia. During castration a like phenomenon is observed when the ligature is tightened around the cord. In pre-anæsthetic days death at this moment occasionally supervened. In tracheotomy death often results the moment the trachea is incised.

Psychical causes so often produce an evanescent depression of the circulation that, within rather wide limits, the result may be said to be physiological. Where the physiological yields to the pathological state cannot be determined. Excessive joy or grief, anger and fear, may give rise to prostration varying in severity like that of traumatic origin. Relaxation of the sphincters from fright is very often seen in children. Polyuria, the induction of profuse diarrhœas, and premature delivery may all be cited as instances of mild shock from emotional causes. The special senses, particularly that of hearing, are at times permanently impaired by painful emotions. Whether the latter can produce a fatal shock without corporeal injury of any kind in a healthy individual is very doubtful. The deaths attributed to it have for the most part occurred in persons in whom the circulatory organs had been impaired by the previous degenerative changes of age or of disease.

In the category of psychical shock might be classed railroad shock in which, so far as can be seen, no physical injury has been sustained. The shaking up of the body, with the dread of impending death, so impairs the equilibrium of the cerebro-spinal centres that resultant shock is of more than ordinary severity and duration. It is quite characteristic of this variety of shock that it is often late in develop-

ing, hours or days elapsing before anything is complained of. Restlessness and excitability, disturbed sleep and migrating pains, want of appetite, and lack of interest in current events of even a personal nature, are further evidences of this variety of shock, of which it is further characteristic that the symptoms are for the most part purely objective, and therefore most readily made the subject of medico-legal inquiry. The discussion of railway shock at length is beyond the scope of this article.

Some poisons, like the cyanide of potassium and veratrum, produce shock by directly depressing the heart. Others, like the mineral acids when ingested, produce shock like an ordinary trauma by the destruction of tissue and the impressions made on nerve-fibres. Far more important from the point of view of frequency of action are the toxic agents generated within the body and carried into the circulation to affect primarily the nerve-centres and through them the vaso-motor apparatus. The depression attending a congestive chill, the rigor following the use of an unclean catheter, the chill of a beginning pneumonia or of puerperal fever, may be cited as instances of shock following the overwhelming of the circulation by septic material. So simple an operation as internal urethrotomy has not infrequently been followed by death in twenty-four hours with the symptoms of shock. The opening of large joints or of the peritoneum was generally followed by the same disastrous results in pre-antiseptic days. Where sepsis is associated with gangrene the shock is often rapidly fatal. A healthy young man was struck in the popliteal space by the prong of a dray. The knee-joint was opened, but there was no other injury. When seen an hour later shock was marked. Two hours later he was delirious; death resulted thirty hours after the injury, the limb having become gangrenous to the trunk. In an extensive burn recently seen the temperature had risen to 105° F. six hours after the injury. Shock often means *sepsis acutissima*.

The marked features of shock depend on a depression of the function of the circulation. It is claimed by Jourdan that the pulse is at first reduced in frequency. This view is not supported by clinicians generally. Probably in all cases of considerable severity it is rapid and feeble, irregular, and often intermittent. The arteries are small and the circulation through the capillaries sluggish. The skin is cool to the touch. The lips and conjunctivæ are pale and bloodless. The face is pale, often of an ashy hue, and covered with beads of perspiration. Bleeding from wounds is slight. There is ordinarily a reduction of temperature of two or even three degrees. Respiration is shallow. The eyes are lustreless, but there is usually no expression of anxiety. Extreme languor is characteristic of severe shock. The patient, though conscious and answering in monosyllables in a voice scarcely audible,



is indifferent to everything about him. The sensorium is blunted and pain is scarcely felt. The protrusion of bones through a limb that is crushed causes no pain; only when a voluntary movement of the injured part is made is pain experienced. The anal sphincters are often parietic. Retention of what little urine the flagging circulation through the kidneys permits to be excreted is the rule. In severe cases death may ensue at any time within twenty-four or forty-eight hours without any evidence of increased energy on the part of the circulation. Often in the fatal cases, particularly if hæmorrhage complicates the clinical picture, other phenomena supervene. The hands appear shrunken; there are dimness of vision, numbness of the extremities, and chills or convulsions. Repeated attacks of syncope, muttering delirium, and coma may precede death. When reaction ensues it is usually inaugurated, as in cerebral concussion, with vomiting; the pulse decreases in frequency; the temperature rises to or above the normal, and color again returns to the face. In very many cases the reaction is slight, and, particularly in individuals of advanced age, is likely to be evanescent. Alternating periods of temporary reaction and depression are witnessed until a fatal prostration supervenes.

Travers was the first to call attention to an erethistic form of shock which he termed "prostration with excitement." It differs from the more common variety chiefly in the psychic phenomena. While consciousness lasts the patient is wild with anxiety. He is for ever changing his position, struggling for air. A limb that is crushed may be tossed about until the audible creaking of the bones makes the bystanders shudder. The patient is unconscious of it. He is oblivious to everything but his impending fate. Usually delirium of a muttering or violent kind soon supervenes and the scene is ended in coma. This form of traumatic shock is frequently encountered in excessive drinkers, and in the wards of our public hospitals it is seen in fully one-fourth of the fatal cases of shock.

Fortunately, shock does not always present the gravity of symptoms above detailed. Cheever has epitomized the degrees of shock as apprehension, fluttering, sweating, chilliness, pain, vertigo, nausea, faintness, convulsions, unconsciousness, and collapse. In mild cases a combination of one or more of these symptoms is often observed. As in cerebral shock, they often disappear with great rapidity.

The general organization of an individual largely influences the degree of shock. Persons of a nervous temperament bear traumatism badly, and in this regard women seem to suffer less from shock than men. Persons advanced in years suffer more from shock than persons under forty, and as a rule children suffer less from it than adults. Probably it is because the functional influence is less potent and the circulatory apparatus as an entirety is more active. When shock is



very marked in children it will generally be found attributable to hæmorrhage. Children bear the loss of blood poorly. In adults also hæmorrhage adds greatly to the severity of shock. Many of the symptoms, such as the collapse, can be produced by hæmorrhage alone. In the treatment of shock the recognition of this fact is vital. In persons enfeebled by organic diseases shock is likely to be severe. Degenerative changes of the heart, the liver, and particularly of the kidneys, may cause even minor injuries to be followed by fatal shock.

**Treatment.**—The principles enunciated in the treatment of cerebral shock underlie the therapy of general concussion. To maintain the body-heat and to support the flagging circulation, to remove whatever might prolong or exaggerate the condition, are the objects to be sought. Hot-water bottles to the trunk, but separated from the skin by a layer or two of thin flannel, and an abundance of warm covering, but not too much, lest respiration be impeded, are important. Rest as far as possible should be given the patient; moving him about from one position to another or from bed to bed is pernicious. Until reaction has set in the clothes should not be removed, except to an extent sufficient to permit an examination. This should always be limited to determining that shock is not maintained by hæmorrhage. A mangled member should be loosely wrapped in towels saturated with sublimate solution and kept elevated on a pillow until a permanent dressing can be applied. Where collapse is threatened from hæmorrhage the latter must be arrested. A bleeding mutilated limb can often be severed with a few strokes of the scissors, and the vessels tied without an anæsthetic and without inflicting much pain. Formal amputation can be done when reaction has partly set in. In the medicinal treatment of shock the subcutaneous method gives the quickest results. Ether, nitro-glycerin, camphorated oil, or whiskey can be injected under the skin as the urgency of the occasion demands. Three or four injections of 1 drachm each of sulphuric ether or of whiskey may be administered. The pulse generally rallies immediately after the injections. To administer stimulants by the mouth is often worse than useless. The patient may be unable to swallow; the effort but increases the prostration. Absorption by the stomach, if the stimulants can be made to enter it, is also deficient. If there has been much hæmorrhage a copious enema of hot water and brandy is indicated. In severe cases of shock with collapse from depletion, an intravenous injection of a hot salt-solution will occasionally induce reaction when other methods have failed. The solution should be in the proportion of 1 to 200 and the temperature about 100° F. Since this intravenous method has been advocated in the treatment of the collapse of cholera the transfusion of blood has been almost en-

tirely supplanted. The circulation cannot regain its force because the heart-pump is empty. Therefore elevation and bandaging of the limbs are often indicated while the salt-solution is being prepared. Among the agents highly recommended in shock is digitalis. In cases in which moderate shock continues for hours or days, and in which the patient reacts imperfectly and relapses, digitalis has proven very valuable. Half-drachm doses administered every hour will usually in protracted cases bring about gradually a condition of the circulation approaching the normal, without at any time inducing sudden changes.

In recent years hypodermic injections of sulphate of strychnia in  $\frac{1}{30}$  to  $\frac{1}{10}$  grain doses have been shown to be of great value in the treatment of shock by increasing and sustaining blood-pressure. A further valuable aid is artificial respiration. The blood in shock is insufficiently supplied with oxygen. This is supplied by artificial respiration, and consequently the heart's action is improved and the blood-pressure increases.

A very important indication in the treatment of shock is the alleviation of pain and the procuring of sleep. Therefore morphine in  $\frac{1}{2}$ -grain dose, repeated if necessary, will be required in almost every case of severe shock. Were we restricted to the use of one agent in the management of shock, we should select this one. In the cases of prostration with excitement it is indispensable. If it is possible to procure sleep for the sufferer, much has been done toward placing him in the way of reaction.

Until reaction has supervened the patient is in no condition to bear the added trauma of an operation. Occasions may arise where operative interference becomes imperative notwithstanding the presence of shock. The necessity for checking hæmorrhage and the informal removal of mangled members has already been mentioned. In cases of strangulated hernia the shock is often severe *ab initio*. To wait for reaction before attempting reduction is out of the question. In acute intestinal strangulation in perforating wounds of the abdomen, in rupture of the uterus, the presence of moderate shock is no contraindication to operative interference. If anæsthesia is required, it should be made as short as possible; that by ether, being more stimulating, should be given the preference.

**Prophylaxis.**—In the mitigation of shock following major surgical operations anæsthesia comes first in importance. Anæsthesia lasting for more than an hour by reducing the animal heat doubtless contributes to the shock. Anæsthesia of shorter duration does not diminish the body-temperature. Hence anæsthetics should not be administered until the surgeon is prepared to operate, nor should they be continued longer than is necessary. Consciousness returning tardily, sutures can

be introduced and dressings can be applied after the anæsthetic has been removed. An operation should never be begun until complete anæsthesia has been obtained. To diminish the shock of anæsthesia by eliminating the struggle of the first stages a hypodermic injection of morphine and atropine should always be given. The operation itself should be done as quickly as is compatible with good work. Shrady emphasizes the importance of *rapid operating* as an element in the prevention of shock. All operations should be done as rapidly as compatible with carefulness and thoroughness. Prolonged anæsthesia and tedious operating favor shock. "Quick operation is followed by quick reaction."

Exposure of large wound-surfaces, thereby facilitating the reduction of temperature, is to be carefully guarded against. In large hospitals a steam or hot-water coil may be placed within the operating table to maintain artificial heat should it be required. An abundance of warm blankets, bottles of hot water, or heated bricks should always be in readiness whenever a major operation is contemplated. In the prophylaxis of shock following operations the prevention of hæmorrhage is of prime importance. In operating on the extremities the Esmarch straps, the hæmostatic forceps, and preliminary elevation of the limb and buried ligatures have largely eliminated this source of shock. Compression with temporary dressings will almost always check the oozing. In operations in the abdominal cavity and the neck, vessels should be ligated before they are divided. In operations upon the abdomen or pelvis in which the abdominal cavity is opened, normal salt solution may be introduced and left in the peritoneal cavity. The shock following such operations is thereby greatly reduced. In operations on the brain, Dana believes that the danger of shock is lessened by getting through the skull quickly and without hammering. Therefore craniectomy gave a mortality of 90 per cent. when the hammer and chisel were used ; whereas now with the electric saw the mortality is not over 5 or 6 per cent.



## PLEURAL EFFUSION AND EMPYEMA; AB- CESS AND GANGRENE OF THE LUNG.

By A. J. McCOSH, M. D.

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### PLEURISY WITH EFFUSION.

**Etiology.**—In considering the etiology of pleurisy with effusion there is a growing tendency to attribute this disease to infection by micro-organisms. Proof, however, that all cases of pleurisy are due to such infection is still wanting, and it cannot as yet be positively affirmed that every case of pleurisy is caused by bacterial invasion. Exposure to cold and rheumatism cannot be entirely disregarded as etiological factors. They certainly hold an important position as predisposing, if not as exciting, causes. Traumatism should probably be classed as a predisposing rather than an exciting cause of pleurisy. The pleurisies which complicate the contagious diseases, such as scarlet fever, measles, typhoid fever, and influenza, are probably due to irritation of the pleura by the specific poison of the disease.

The main reason for this increasing tendency to attribute all cases of so-called "primary" pleurisy to bacterial infection is based upon the fact that in so many patients a tubercular element has sooner or later made itself manifest. It may be elicited by careful questioning as to their past history, or it may be brought to light by their future behavior, or it may only be discovered through a pathological examination of some secretion or tissue during life or after death. A large proportion of pleurisies, probably from 35 to 40 per cent., are known to be tubercular in origin. A smaller proportion are caused by other micro-organisms. There still remains a considerable number of cases whose origin cannot be positively determined. A microbic origin cannot be excluded merely because the examination of the fluid or of the culture gives a negative result as far as the presence of micro-organisms is concerned, for it is well known that the culture test of fluid from unquestionably tubercular pleurisies will frequently give a similar negative result. In a pleuritic exudate the tubercle bacillus is so scarce and so easily destroyed that with our present method of culture examination the fluid is apt to be reported as "sterile." For this

reason a fluid so reported is now considered to be probably tubercular in origin. Inoculation tests are more accurate, and should be employed in every case where it is of importance to ascertain the exact cause of the pleurisy. Even these, however, result negatively in a certain proportion of cases ; hence it cannot be proved that every case of pleurisy has a microbic origin, though the evidence is strongly in favor of such a statement.

In a general way it may be stated that the following etiological factors are recognized in the production of pleurisy with effusion :

**EXPOSURE TO COLD, DAMPNESS, ETC.**—The exact way in which this more and more discredited “primary” factor may bring about a state of inflammation in the pleural membrane is not at all settled. The possibility of an actual lowering of temperature of the pleural membrane itself resulting in a corresponding inflammatory reaction on its part, being ruled out by the physiological conditions prevailing in the chest, we are driven to the theory of a reflex vasomotor disturbance caused by the effect of the cold on the surface of the body, and its determination to the pleural in preference to other tissues. It is more probable, however, that the exposure is merely an indirect or predisposing cause, producing, as it does, a lowered vitality of the pleura, and consequently a weaker resistance against infection, and a more favorable soil for the growth and development of some specific micro-organism.

**RHEUMATISM.**—It is known that rheumatic and gouty patients are rather prone to attacks of pleurisy of varying degrees of severity. Many of the milder cases doubtless escape observation, for unlike the serous membranes in the joints, the pleural membranes cease to be the seat of acute pain as soon as their surfaces become separated by even a small amount of fluid.

As to the actual etiological factor or factors in the so-called “rheumatic” cases we are of course as much in the dark as we are concerning the primary cause of rheumatism itself. Some clinicians are inclined to believe that many of the hitherto so-called “primary pleurisies” are in reality rheumatic in origin (especially when existing on both sides of the chest), even if no other part of the body shows evidence of rheumatic disturbance. It is not at all unlikely that many of these “rheumatic” cases will at a later period be classified under some other head, probably that of a specific microbe.

**TUBERCULOSIS.**—As will be readily seen from the perusal of the statements just made, the exact limit which should be accorded to tuberculosis as an etiological factor in pleurisies with effusion cannot be positively stated. It can, however, be affirmed that the tubercular factor is an extremely frequent and important one, especially among adults. Thus, Le Damany found that in 55 cases of pleurisy there

were evidences of tuberculosis in 47 when a syringeful of the fluid was injected into guinea-pigs. Some still hold the view that the tubercular pleurisies are not as frequent as is generally stated, and in support point to the many cases of pleurisy with effusion which heal completely after proper procedures have been carried out. This fact, however, does not prove the absence of the tubercular element, for we know that other tubercular processes will heal, as, for example, tubercular peritonitis after the abdomen has been opened and drained.

The starting-point in these tubercular pleurisies may be from—(a) Tubercular bronchial glands. (b) Some small, perhaps unrecognized tubercular lesion in the vicinity of the pleura, as a tubercular focus in the lungs, or in the ribs, or in any of the bony structures adjacent to the thoracic cavity, as in the spine, sternum, etc. (c) A tubercular focus anywhere in the body, and the smaller and more remote the focus the less chance will there be of its being discovered and brought into etiological relation with the secondary pleurisy.

The most common way in which tubercular pleurisy occurs is undoubtedly by the extension of a neighboring tubercular focus in the lung itself to the pleural layer; the more or less rapid breaking down of that focus being succeeded by the infection of the pleura. The resulting exudate will be either clear or tinged with blood, the latter being the result of a slight hæmorrhage from the ulcerated tubercular focus or from the intensely hyperæmic pleural membrane in its first stage of congestion.

**TRAUMATISM.**—This is a not infrequent cause of pleurisy. As a rule, however, the inflammation or rather hyperæmia, does not proceed beyond the formation of a fibrinous or slightly sero-fibrinous exudate unless some septic element be introduced. Thus we see that many patients even with extensive fractures of the ribs escape with a comparatively slight pleurisy at or near the site of the fractures, whereas an infected compound fracture in the same locality will be followed by the formation of a liquid exudate which will subsequently become purulent.

If there be a traumatic lesion of the thoracic duct true chyle may be found in the effusion. This must not, however, be confounded with the fluid obtained in pleurisies associated with either cancerous or tubercular processes of the pleura, the latter containing broken-down leucocytes, epithelial cells, crystals of cholesterin, etc., whereas the former is seen under the microscope to consist simply of a fat emulsion, the chyle itself.

**SEPSIS** is a common cause of pleurisy with effusion. The lymphatics of the pleura are very prone to transmit any septic element from surrounding or even remote foci. Thus we find a pleural exudate forming from an osteomyelitic process in some one of the long



bones of the body as well as from an abscess in a more immediate neighborhood, as that of the chest-wall.

An acute axillary adenitis is not uncommonly followed by a septic pleurisy, the starting-point having been perhaps some apparently insignificant wound of the fingers, hand, or forearm, the lymphatic glands having failed to completely arrest the progress of the germs on their march along the lymphatic route. In a similar way an ulcerating process in a carcinoma of the breast is often followed by a pleural exudate.

Septic processes in the abdominal cavity form a frequent source of pleural effusion, the lymphatics of the pleura communicating freely with those of the peritoneum by means of the lymphatic vessels in the diaphragm. Thus septic processes in the subphrenium are particularly prone to infect the pleura at an early date, such as abscesses of the liver, breaking-down carcinomatous masses about the stomach, or perforating gastric ulcers, echinococcus cysts of the liver; or the infection may come from a still more remote source, an appendiceal abscess.

The pleural exudate may represent the result not of the transmission to it of the germs by the lymphatics from a local septic focus in the vicinity or at a distance, but rather the transmission to it of germs by the blood in the course of a general septicæmia, all the serous membranes sharing, perhaps, alike in the process. The micro-organisms which usually produce such pleurisies are the streptococcus and the staphylococcus. Probably they represent the early stage of an empyema. A streptococcus infection is apt to be more acute than is a staphylococcus, the development of the latter being slower and resembling more a tubercular pleurisy.

Among the septic pleurisies we may perhaps place with propriety those pleurisies arising from influenza, though the specific germ has not been found and isolated in all cases. We may also place under this heading those pleurisies which result from septic processes of the tonsils or other tissues, and those occurring with the various exanthemata, measles, scarlet fever, and with whooping cough, typhus fever, etc. In the exanthemata the poison is doubtless conveyed by the blood. Here also may be included those pleurisies arising as the result of the typhoid bacillus.

**THE DIRECT EXTENSION OF A NEIGHBORING INFLAMMATORY PROCESS.**—Many of the sources of this kind have already been mentioned in the previous paragraphs. Such an extension to the pleural membranes almost always occurs in a pneumonia, the amount of effusion between the layers of the pleura varying, of course, with the intensity of the pneumonic process. In these cases in the aspirated fluid are found—Fränkel's diplococcus; the staphylococcus pyogenes, or the streptococcus, or the fluid may be sterile.

As will be seen later when speaking of empyema, most of these meta-pneumonic pleurisies occur in children.

The inflamed pericardium may be the starting-point of a pleurisy by extension. This is rather the rule, for a certain amount of pleurisy is found to exist in every case of pericarditis.

**SYPHILIS.**—This disease seems to be a cause in certain cases. It is certainly uncommon in this country as a sole and distinct etiological factor. French authors specially describe a "secondary" and a "tertiary" form—the secondary form occurring seemingly as a part of a general infection, the tertiary one rather as a pleurisy by extension from some neighboring tertiary lesion.

**ENDOCARDITIS; NEPHRITIS; CIRRHOSIS.**—As a rule the fluid accumulated in these cases is rather a serous transudation into the pleural cavity due to a local *venous stasis*, and represents a general dropsy. This dropsical fluid contains a smaller amount of albumin and is therefore less coagulable. The transudation is usually bilateral—the amount in each chest, however, oftentimes varying considerably. A similar venous stasis may exist from the pressure of tumors in the vicinity, as of the mediastinal glands.

Changes in the composition of the blood may also give rise to this serous transudation.

**PNEUMOTHORAX.**—The presence of air in the pleural cavity may act as the exciting factor and a sero-fibrinous exudate result.

**TUMORS OF THE PLEURA.**—The small fibromata which are not uncommonly seen in the pleura do not appear to excite the pleura to inflammation by their presence. This is not the case, however, with malignant tumors, which usually occur from—(a) Direct extension of similar tumors of the lungs (these lung-tumors being themselves often secondary to similar tumors elsewhere). (b) Metastatic nodules from malignant tumors of other organs (*e. g.* carcinoma mammæ, osteo-sarcoma of femur, etc.). (c) Some are primary new growths; such are endothelial carcinomata, which are rare. (d) Parasitic growths such as echinococcus and actinomycosis. In the latter the tendency is to adhesions rather than fluid.

**HÆMORRHAGIC INFARCTION OF THE LUNG**—often occurring from the plugging of a terminal pulmonary arteriole. The inflammation is therefore a cortical one and the pleura is soon invaded.

**ABSCESS AND GANGRENE OF THE LUNG.**—The cases occurring from these causes may be due either to sepsis or to invasion by extension through the lung-tissue. A *distinction* should be made between—(a) A blood-effusion into the pleural cavity (*hæmato-thorax*) and (b) Pleurisy associated with a blood-tinged exudation.

(a) In *hæmato-thorax* the etiological factors are—(1) Traumatism, as from fracture of ribs, where the pleura and even the lungs may be

lacerated and the blood comes from a ruptured vessel. (2) The bursting of a blood-vessel in the neighborhood, such as an aneurism of the aorta or from a vessel in a carcinomatous or sarcomatous tumor, the tumor, however, not having encroached sufficiently on the pleura to cause an exudate. (3) The pressure of a tumor on the large intrathoracic veins.

(b) As causes of the *blood-tinged exudation* in a pleurisy with effusion may be mentioned—(1) The ulceration of the walls of a blood-vessel in or near the pleura in an ulcerating tubercular lesion. (2) The hyperæmic condition of the blood-vessels in the pleural membrane in cases of intense congestion at the outset of the inflammation. (3) Septic disease as a result of the embolic affections of the lungs. (4) Cases of scurvy and of purpura hæmorrhagica. (5) The general hæmorrhagic diathesis (when associated with pleurisy with effusion). (6) Pernicious anæmia and leukæmia.

#### TREATMENT.

The treatment of pleurisy is practically the same as was so fully and clearly described in Volume II. It will not be amiss, however, to add what has been learned by the experience of the past five years.

**MEDICAL TREATMENT.**—It is important if possible to ascertain the cause of the pleurisy and direct our attention toward its removal. For example, in rheumatic subjects the administration of anti-rheumatic medicines such as sodium salicylate, oil of wintergreen, or salophen is indicated. In addition to treatment of the cause, rest in bed, fluid diet, and strapping of the chest, and perhaps tincture of aconite should be employed in the acute stage before the effusion has appeared. In regard to counter-irritation opinions differ and will continue to differ.

In the *stage of effusion* the two indications are for depletion and aspiration of the fluid.

**DEPLETION.**—The dry diet seems to be more useful in restraining the exudate than does the fluid diet. The amount of fluids drunk should be restricted as much as possible. If fever is absent or only slight, a diet of meat, dry bread, and eggs should be employed, with a limitation of the fluid to eight or ten ounces in the twenty-four hours. Every morning an hour before breakfast a saline cathartic, as half an ounce of Epsom salts, should be given. The urine should be watched, and, if scanty, diuretics such as the potash salts may be given with advantage. The skin must also be kept active. Other indications must be met by appropriate remedies.

**ASPIRATION.**—It was formerly the custom not to aspirate as long as fever was present unless pressure-symptoms were marked. It was also formerly the custom to wait at least three weeks before removing any of the fluid. Modern practice, however, is not influenced by



those considerations and aspiration is now employed irrespective of fever and irrespective of any certain duration of the disease. Thoracentesis is always indicated—

- (a) When the fluid is sufficient to cause dyspnœa.
- (b) When the fluid reaches as high as the third rib, whether or not there be symptoms of pressure.
- (c) When the heart is displaced by the pressure of the fluid.
- (d) When the fluid resists absorption for longer than ten days in spite of medical treatment.

Another indication which is observed by many physicians, but which is not absolute, is to aspirate when the level of the fluid rises above the angle of the scapula.

As already stated, fever should not be considered a contraindication to aspiration. Not infrequently after removal of a part of the exudate the temperature will at once fall never to rise again.

The old idea that aspiration occasionally caused the conversion of a clear effusion into a purulent one is at the present day almost abandoned. Possibly in former times an unclean needle or syringe may have produced such a result, but at the present time such an accident would be inexcusable.

The advantages of early aspiration are that adhesions may be prevented and the course of the disease shortened. This latter is especially true in regard to children, in whom rapid cure is apt to follow a single aspiration.

The *diagnosis* of pleurisy is not complete without the use of the exploratory puncture. With ordinary caution this should be absolutely harmless. An ordinary hypodermic syringe is not well adapted for this purpose. The needle is too short and of too small a calibre, and the great difficulty of disinfecting a leather piston should exclude the use of this instrument. There is but little excuse for its employment when so many syringes capable of sterilization by boiling can be found. In these instruments the piston is made either of asbestos or rubber, or it may be in the form of a solid rod of metal or glass.

It is of the utmost importance that the skin be carefully disinfected before the needle is inserted. A thorough scrubbing with green soap followed by alcohol, ether, and bichloride solution should invariably be made. The syringe should be removed with sterilized hands or forceps from the vessel in which it has been boiled in a soda solution. The needle should not be plunged in, as is sometimes directed, but it should be slowly and steadily pushed through the chest-wall until by the free oscillation of its point it can be determined that a cavity has been entered. This is generally at the depth of about two inches. The needle used for this purpose should be at least three inches in length.

Should the ordinary hypodermic syringe be used, a prior disinfection must be done by soaking it for at least twenty minutes in a solution of carbolic acid, 1 to 20. When removed from this by sterile hands it is not ready for use until it has been washed out with *sterile* water, for as a rule a culture should be obtained from the fluid withdrawn by the syringe, and enough of the carbolic will remain to destroy the germs in the fluid.

The diagnosis having been made and thoracentesis being indicated, the aspiration can be made by one or other of the aspirating syringes described in Vol. II. The instrument, however, should invariably be tested before the needle is introduced. The Potain or Dieulafoy aspirating syringes are the most serviceable. The needle used should have a diameter of at least 1 mm. and be at least three and a half inches in length. The whole apparatus must be carefully sterilized before use.

The use of the trocar and canula has been abandoned as unsatisfactory.

The *amount of fluid withdrawn* must be regulated by the condition of the patient, but the chest should never be entirely emptied, even were this possible. If cough becomes distressing, or if the patient experiences pain, dyspnoea, or faintness, or if the fluid becomes bloody, the needle should be at once withdrawn.

If during the aspiration the needle becomes plugged by clots of fibrin, it may be cleaned by passing through it a sterile stylet. If this fails to clear away the obstruction, fluid should never be syringed back through the needle, but the needle should be removed and reinserted.

After use the syringe and all its attachments should be thoroughly cleansed with hot soda solution.

Frequently, especially in children, a single aspiration will be at once followed by improvement which will continue. A second or even a third aspiration may be needed, and even then the fluid may re-accumulate. In such cases when the pleurisy may be said to be chronic the indications are for a free incision and drainage, the details of which are discussed under Empyema. Of course, in hydrothorax that is due to chronic heart- and kidney-disease these remarks do not apply, as in such cases repeated aspirations must be employed until the original disease has either been cured or has ended fatally.

#### EMPYEMA.

**Etiology.**—For the production of an empyema the pus-producing microbes must be present. The inflammation (*a*) may be purulent from the start, or (*b*) a pleurisy with effusion may be converted into an empyema by the addition of the pyogenic bacteria.

In enumerating the etiological factors of empyema we cannot do better than to say that they are much the same as those mentioned

under pleurisy with effusion, the empyema being simply a further stage in the same process, whether the pus be produced from the start as a result of infection with pyogenic organisms or whether it be due to a later infection engrafted on a sero-fibrinous exudation.

THE GERMS found are—*Diplococcus pneumoniae* (Fränkel's pneumococcus). *Streptococcus pyogenes*. *Staphylococcus pyogenes aureus*. *Tubercle bacillus*. *Typhoid bacillus*. *Colon bacillus*. (A few others in rare cases).

*Diplococcus Pneumoniae* (Fränkel's).—This germ is found in a large proportion of meta-pneumonic empyemata. Most of the purulent pleurisies in children (about 75 per cent.) are meta-pneumonic. This germ is short-lived and is not very virulent, hence most of the empyemas in children are more easily cured than is empyema in adults. It is found in a certain number of cases of empyema where no lung-lesion can be discovered. This does not, however, rule out absolutely the evidence of a previous pneumonic process, for in children—a class in which a large proportion of these cases are found—a central pneumonic process not easily diagnosed often occurs. This has doubtless been the case in many of the patients above referred to, and the presence of the pneumococcus is the only guide to the etiological factor. The exact route taken by this germ on its way to the pleura has not as yet been clearly proven; the lymphatics, the lung-tissue, or the blood-current may be the route chosen. There is nothing unreasonable in the assertion that the germ may travel into the pleura and there set up a pleurisy without causing any pneumonia along its path. The pleural membranes may happen to be a more suitable soil for its development at that time than is the pulmonary tissue.

This bacillus is found in about one-third of all cases of empyema in children, being found in at least 60 per cent., and in adults in 20 to 25 per cent. of the cases. It often, but not invariably, produces a thick, viscid pus of greenish tinge.

*Streptococcus Pyogenes*.—This germ is found in about one-half of all cases of empyemata in adults. In children it is uncommon. The streptococcal empyemata are clinically of much more severe type than the pneumococcal. The influenza cases seem to come under this group where the streptococcus is found in the pus. When the germ exists in the purulent fluid it has probably in many cases been carried to the pleura from a primary focus in some other part in the body. This primary focus may well be overlooked, especially if it be small and in the lungs. As a starting-point for the germ, some one of the various lesions mentioned as etiological factors in pleurisy with effusion may sometimes be discovered if the patient is carefully examined.

This germ is found as the chief factor in certain pneumonias fol-



lowing the infective diseases. In many cases this is doubtless the source from which it enters the pleural cavity.

*Staphylococcus*.—This germ alone is found in the cultures from a few cases. It is, however, more often found associated with other bacteria. Usually in such cases the other forms of associated bacteria determine the quality of the inflammation and the properties of the purulent fluid. This germ also, doubtless, comes from the lungs, as we find it there in some cases of lobar and of broncho-pneumonia.

It was formerly supposed, when a previously clear pleural effusion became purulent as the result of aspiration, whether for diagnosis or for treatment, that this effusion had been infected either directly from the needle or from the germs in the air reaching the pleural cavity through the wound. We know now that while this may of course occur, still a certain number of these effusions will become purulent if left to themselves. The pyogenic germs doubtless reach the fluid either through the inspired air or through the blood-current. The danger of infecting the pleural exudate even when an unclean needle is used is not very great, as usually the exudate possesses sufficient germicidal properties to destroy a small number of germs.

*Bacillus Tuberculosis*.—While this germ figures strikingly as the etiological factor in a large percentage of pleurisies with effusion, we know that it is found in but a small percentage of all cases of empyema. While the germ, however, is *found* microscopically only in a few cases, the results of inoculation experiments prove that apparently sterile exudates are in reality tubercular. At the present time the withdrawal of absolutely sterile fluid from an empyema places the case clinically among the tubercular ones.

The tubercular cases are usually chronic, resulting in great pleural thickening which under the microscope shows typical tubercular inflammation. The pus is often thin, and may be streaked with blood, and is rather grayish as distinguished from the green pus of the meta-pneumonic cases.

For the sake of completeness may be mentioned as occasional factors—(a) The *encapsulated bacillus of Friedländer*, (b) The *typhoid bacillus*, (c) The *Micrococcus lancetolatus*, and (d) The *Bacillus pyocyaneus*. The inflammation set up by the typhoid bacillus is more apt to be a pleurisy with effusion, which may well become infected at a later period by one of the other micro-organisms from some septic focus elsewhere in the body.

In cultures from 41 cases of empyema occurring in the Presbyterian Hospital, New York,<sup>1</sup> there were found: sterile, 12; pneumococcus, 7; streptococcus (alone), 5; staphylococcus (alone), 1; *Micrococcus lancetolatus*, 3; diplococcus, 1; *Bacillus coli commune*, 1; tubercle bacillus,

<sup>1</sup> Article by Hartwell, in *Presbyterian Hospital Report*, vol. iv.

1; bacillus pyocyaneus, 1; undetermined cocci, 1; pneumococcus and streptococcus, 2; pneumococcus and micrococcus lanceolatus, 1; pneumococcus and diplococcus, 1; pneumococcus and other cocci, 1; streptococcus and tubercle bacillus, 1; streptococcus and staphylococcus, 2.

**THE SAPROGENIC MICROBES.**—These are the microbes which add to the effusion the element of putridity or gangrene. Among them we note *Löffler's bacillus*; *Bacillus coli communis*; *Leptothrix*.

A gangrenous pleurisy may be either gangrenous from the start or the gangrenous element may be added secondarily and determine its putrid quality. Any focus containing the gangrenous elements may become the source of the gangrenous pleurisy. Such a focus may exist in the gastro-intestinal tract anywhere from the pharynx to the anus, as in a carcinoma of the œsophagus, stomach, or intestine, or suppurating processes about the intestines.

In the lungs, bronchiectatic and phthisical cavities which have become gangrenous are within easy reach of the pleural lymphatics.

Breaking-down hydatid cysts may also furnish the gangrenous element.

**Treatment of Empyema.**—The diagnosis having been established by an exploratory puncture, the pleural cavity should be opened and drained as soon as possible. Aspiration is not to be recommended. The use of the trocar and canula is not advisable. Continuous siphon-drainage such as Bulau's is inconvenient and inefficient in the majority of cases. The case must be treated as one of ordinary abscess and the pleural cavity must be freely opened.

When prepared to operate, the rule should always be observed to make an exploratory puncture with an aspirating needle at the point where the incision is to be made, and not to begin the operation until pus has been found.

As a rule the patients will need an anæsthetic. Occasionally, if excision of a rib is not required, the operation can be performed under cocaine. Anæsthetization should never be profound.

Opinions differ as to the best spot at which to make the opening. It is not essential that the pleural cavity should be opened at its lowest part, though it is of advantage to do so. The seventh interspace at the mid-axillary line or the eighth interspace at the angle of the scapula is generally chosen.

When the patient is anæsthetized care should be exercised not to roll him too far over on the sound side, as there is danger of compressing the uncrippled lung. A slight tilting by sand-bags under the back will suffice.

*Shall a simple incision be made, or shall a portion of a rib be*

*excised?* On this point opinions differ. In children it does not seem, as a rule, necessary to remove any part of a rib. A simple incision and drainage for a week or so will often be sufficient to effect a cure. If a cure does not result, a portion of rib can be removed at a later date. In adults, however, the best practice is to remove an inch or more of the seventh or eighth rib. The opening thus obtained will secure better drainage, will probably shorten the course of the disease, and will also permit of a digital inspection of the lung and pleural cavity. Some cases, however, will recover promptly without the removal of the rib, and it cannot be laid down as an absolute rule that a portion of the rib must be excised. In chronic cases, however, of long standing a portion of one or more ribs should always be removed.

The fluid should be allowed to escape slowly.

IRRIGATION, as a rule, should not be employed at the time of operation. It is a good rule never to employ irrigation as long as the patient is fully under the influence of an anæsthetic. More than one death has been caused by neglect of this rule. In cases, however, where the pus is foul, or where there are present large masses of fibrin, or where the costal pleura is coated with tough and thick layers of lymph, irrigation is often indicated. The fluid employed must be hot, and should be normal sterile salt solution. There is no advantage in the use of antiseptic solutions, and the pleura absorbs so rapidly that there is some danger of systemic poisoning. While the irrigation is being employed the patient should be allowed to recover partially from the influence of the anæsthetic.

Elaborate plans of drainage are useless. One or two simple rubber drainage tubes with a calibre of half an inch inserted just within the pleural cavity are all that is needed. Care should be used to fasten the tubes externally by a large safety-pin or suture, so that it may not be sucked into the chest and cause a permanent fistula, and perhaps a suit for malpractice. The sterile dressing of gauze and cotton should be abundant, so that it may absorb the discharge, act as a valve in preventing the entrance of air into the pleural cavity, and at the same time exclude infection from without.

The risk from the operation itself is trifling. The most dangerous part of it is the anæsthetic. It should be most carefully administered and but a small amount should be employed.

AFTER-TREATMENT.—For the first few hours after operation the patient should be allowed to remain quiet on his back. Systematic changes of position which will enable him to empty the pleural cavity must then be begun. He must be raised up and turned over on the diseased side several times daily and later may be encouraged to hang over the side of the bed with the hands resting on the floor. Efforts



should be made to cause the lung to expand. Deep inspirations should be taken. If this fails a series of gallon bottles filled with water should be used (Woulff's bottles), the patient transferring by air-pressure the water from one bottle to another.

As a rule, no irrigation is needed. In favorable cases the tube can generally be removed at the end of ten days or a fortnight and the wound will be closed in from three to five weeks. When the case has been of long standing or when the pus is foul, daily irrigation with salt solution may be necessary. In these cases the duration of the opening may be months instead of weeks. In 46 cases collected by Runeberg the average time of healing was forty-eight days. In the 61 cases of Borivert it was forty-nine days (in 21 of these cases it was less than four weeks). In cases of long standing, especially in elderly patients where the ribs are very rigid and the cavity of large size, the chances of cure without further operation are not very favorable. In recent cases, however, especially in the young where the ribs are elastic and the cavity not too large, the chances of rapid cure are excellent provided the tubercular element be absent.

Should a profuse discharge continue for longer than seven or eight weeks without sign of decrease it is generally an indication that more radical measures may be needed. One of the simplest of these is the insertion of strips of gauze into the pleural cavity, which is thus packed as would be any other granulating cavity. A mild iodoform gauze may be used, but a careful watch must be kept for iodoform-poisoning. The gauze should be removed and the cavity irrigated and re-packed every second or third day. If a successful issue is to be expected, the external opening must be large. Benefit will occasionally be derived from this plan of treatment, but too much must not be expected from it.

COMPLICATIONS.—If the operation has been properly performed, the dangers of sepsis should be almost *nil*. If, however, it should develop, a freer opening must be made and frequent irrigations should be employed.

Another possible complication is abscess of the lung or brain.

Excoriation of the skin about the opening will sometimes be produced by the irritation of the discharge. A frequent change of dressing and the application of a bland ointment, as vaseline with 10 per cent. boric acid or the ointment of zinc oxide, will produce relief.

Suppuration of the chest-wall around the opening may occur. This may need free incisions. Caries of the ends of the rib may also result. Removal of the diseased bone will then be necessary.

In a considerable proportion of cases a permanent fistula will result leading into a large cavity which the lung cannot obliterate by its expansion. If at the end of several months no sign of its

obliteration, one of the thoraco-plastic operations should be performed. Schede's operation, while more severe, seems more effectual than Estlander's. Its advantages consist not so much in the larger amount of chest-wall removed as in the removal of a large area of diseased pleura. The incision is begun at the outer edge of the pectoral muscle about the fourth rib and carried downward in a curved direction to the lower part of the pleural cavity, extending backward as far as the tenth rib in the post-axillary line. It is then carried upward along the vertebral border of the scapula (which is drawn forward by placing the arm across the chest). The large skin-flap, attached above, is then raised and a subperiosteal resection made of all the ribs between the second and ninth, from the junction of the rib with its cartilage in front to the tubercle behind. The rib is best divided by bone-forceps near the middle, the ends drawn outward and broken off at the points above mentioned. The thickened pleura and the intercostal muscles are then cut away. The skin-flap is let fall into place and sutured. Many months must elapse before a cure can be expected from this severe operation.

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### ABSCESS OF THE LUNG.

**Etiology.**—The exciting cause of a pulmonary abscess is the same as that of a suppurating process in any other part of the body, *i. e.* the presence of the pyogenic bacteria, generally the streptococcus or staphylococcus. These germs either gain access to the lungs through septic emboli from a more or less remote focus of suppuration, being conveyed by the blood or lymphatic current or by means of the inspired air. If the infection has been carried by the latter channel, the vitality of the affected portion of the lung must have been lowered by previous disease or by injury. When the infection is conveyed in the blood or lymph-channels a portion of a perfectly healthy lung may break down into an abscess.

If the infection be brought to the lungs by an embolus, this embolus is usually arrested in one of the pulmonary arterioles, and consequently is apt to lodge near the surface and shut off the blood-supply from a wedge-shaped portion of lung. There results a hæmorrhagic infarct which, becoming infected by the germs in the embolus, softens and is converted into an abscess. If in addition the germs of putrefaction gain access to this broken-down area, there results a spot of gangrene. A septic process anywhere in the body may be the starting-point of such an embolus; for example, a septic uterus following

childbirth; sloughing bed-sores; suppurating joints; broken-down mediastinal glands; malignant pustule; glanders; carbuncles and boils; otitis media; a suppurating cancerous mass; an ulcerating appendix; an osteo-myelitis, caries or necrosis of any of the bones especially about the thorax; abscess of the liver.

Any infected wound of the skin, which may have healed superficially, can also furnish the septic element necessary.

Before the introduction of the aseptic methods in modern surgery the wounds made by the surgeon were not infrequently the starting-points of septic processes in various parts of the body. The lungs, being naturally the first organs to arrest the septic emboli, were not infrequently the seat of abscesses thus formed. These cases are but very rarely seen at present. Operations upon some diseased portions of the genito-urinary tract are, however, followed even now at times by the production of an abscess of the lung.

The heart itself may be the source of infected emboli; the pyogenic germs which have attached themselves to the damaged valves or to the vegetations upon these valves, or to the walls of the ventricle in their neighborhood, may be swept away by the blood-stream, to be subsequently lodged in the terminal arterioles. This occurs in cases of malignant endocarditis.

In punctured and bullet-wounds of the lung the pyogenic germs may have been carried in by the weapon or the bullet, and then find an excellent soil in the lacerated lung-tissue, which subsequently becomes converted into an abscess.

In cases of empyema also, especially if the inflammation be of a severe grade, the lymphatics of the pleura and lung may become so choked with the pus as to undermine the lung-tissue itself, which becomes soft and finally breaks down into an abscess.

In some cases of pneumonia spots may remain from which the exudation has not been absorbed. Pyogenic germs are conveyed to these areas either through the inspired air or through the blood or lymphatics, and an abscess is the result.

As an etiological factor traumatism of the chest must be mentioned, with a resulting contusion of the underlying lung-tissue or even a rupture of a portion of it. This may well be followed by infection of the damaged area and the formation of an abscess.

Small areas of pneumonia from the inhalation of fluids or of solid matter—the so-called inhalation or inspiration pneumonia—may likewise become infected by these micro-organisms and break down.

Abscesses, however, most frequently follow some inflammatory condition of the lung, especially in patients who have been debilitated by long-continued illness or alcoholic excesses. In 25 of the 49 cases in which Tuffier opened a pulmonary abscess it was preceded by a



pneumonia. As a rule they do not form in the lungs of the young and healthy unless as the result of traumatism or septic emboli. It is true, however, that occasionally as the result of a pneumonia, la grippe, or pleurisy a pulmonary abscess will result even in the young and vigorous. The vital forces of such patients must have been much depreciated by the original disease. The source of infection can often not be determined, but by exclusion the conclusion is reached that it is carried to the damaged area by the inspired air.

The diagnosis is often difficult. It is of importance, however, that an abscess should be differentiated from bronchiectasis, encysted empyema, and tubercular cavities. Apart from the physical signs the presence of elastic fibres or of the tubercle bacillus in the sputum ought to lead to a correct diagnosis as far as bronchiectasis or tuberculosis is concerned. Differentiation from an encapsulated empyema is not of so much importance, as the treatment for both conditions is very similar.

**Treatment of Abscess of the Lung.**—When the diagnosis of abscess has been made, what shall be the treatment of the case? In an abscess in any other part of the body there can be but one answer to this question, and that answer is free incision, evacuation of the pus, and thorough drainage. A categorical answer cannot be given, however, when the abscess is located in the parenchyma of the lung. It must be qualified, for the successful treatment of such cavities depends much on the special conditions, both local and general, of each individual case. In certain cases the old rule, *Ubi pus ibi incisio*, must be strictly followed. In others it is of equal importance to ignore this rule. In still others, and this forms the largest class, it is difficult to decide whether or not operation is advisable. It is exactly in cases of abscess that lung-surgery has been most successful. Many satisfactory results have followed operative interference. We know how little can be expected from medical treatment; sufficient surgical experience has accumulated to enable us to intelligently contrast the surgical with the medical treatment of this class of cases.

**MEDICAL TREATMENT.**—This will in a measure depend on the general condition of the patient, on the cause of the suppuration, and on the situation and extent of the abscess. In all cases, whatever the cause and whatever the local conditions may be, the indication is for stimulating and supporting treatment. Judicious stimulation and attention to nutrition are of more importance than are drugs or inhalations given for the purpose of exerting an antiseptic action on the abscess-cavity itself. It cannot, however, be denied that benefit may be derived from the use of this class of remedies, as also from drugs which promote free expectoration. The position of the patient is also

of importance. The indications will be discussed in the order of their importance.

**STIMULATION AND NUTRITION.**—The greatest care must be taken to maintain in proper condition the functions of digestion and assimilation. Every effort should be used to prevent any disturbance of the alimentary canal. The expectoration of fetid sputum is apt to cause gastric disturbances and disinclination to take nourishment. Local measures to be considered in a later section are sometimes beneficial in removing the nauseating odor and taste. It is largely on account of the importance of maintaining the digestive functions in proper condition that care must be exercised in the use of drugs. No general rules can be laid down in regard to the character or amount of either food or stimulants. A moderate use of alcohol in one form or another is generally indicated. As a rule whiskey is best, but brandy or some form of wine may be most suitable in certain patients. Even should the pulse be fairly good a moderate amount of alcohol is indicated. Alcoholic stimulation in any form of sepsis is always of great value. If, for example, the pulse is under 100 and of fair quality, 3 or 4 ounces of whiskey in the twenty-four hours will suffice; but if the pulse-rate is 120 or higher and the heart's action feeble, double or treble that amount may be indicated. Of course the manner of its administration must be regulated by the peculiarities of the case.

In addition to the alcohol it is generally well to give strychnine either by mouth or by hypodermic syringe, preferably by the latter. The dose should be gr.  $\frac{1}{30}$  every three or four hours, or, if the heart's action is very weak, as often as every hour. It is not uncommon for patients to complain bitterly of the frequent hypodermic injections, and in such cases it may be necessary to administer this drug by the mouth, provided that it is well borne by the stomach. Should the arterial tension be high nitro-glycerin may occasionally be indicated, in doses of gr.  $\frac{1}{100}$  every three or four hours. Of course other heart-stimulants, as digitalis, strophanthus, etc., may be needed. The bowels should be kept open by gentle laxatives and the action of the kidneys maintained.

**ANTISEPTIC AGENTS.**—These are general and local.

*General.*—Drugs are employed whose elimination is partially accomplished through the bronchial tubes. The balsamic drugs, as turpentine, creasote, and tar, are chiefly employed for this purpose. If they could be used freely considerable benefit might be expected, but the stomach generally cries *halt!* The most easily borne is terpene hydrate or terebené.

*Local.*—Antiseptics can be administered in the form of sprays, inhalations, and gargles. Of the sprays a 1 per cent. solution of car-

boric acid or a solution of thymol 1 : 1000, or a 3 per cent. solution of peroxide of hydrogen, are the most efficient and agreeable. Of the inhalations a combination of creasote (wood), alcohol, and chloroform in equal parts is one of the best, or the formula given on page 658 of Vol. II. may be used. Eucalyptus, either alone or combined with other antiseptics, is one of the most popular local remedies, either in spray or gargle. Any of the antiseptics in weak solution may also be employed as gargles—carbolic acid, boric acid, or peroxide of hydrogen. Some of the semi-proprietary combinations are useful.

It must be acknowledged that medical treatment can be of but little avail. The *vis medicatrix naturæ*, when encouraged by proper food and stimulation of the heart, will accomplish more than drugs.

The most important point in the treatment of pulmonary abscess is the question of surgical interference. Is operation indicated, and if so, when? The decision of this question will depend on three conditions: first, the general state of the patient; secondly, the efficiency of the drainage through the bronchi; thirdly, the absence of general sepsis. Should the patient's general condition remain good, and should there be no marked loss of strength, the operation may be delayed. If on the other hand the strength of the patient should gradually fail, if the pulse should become rapid and feeble, then delay is unjustifiable. Also if signs of sepsis should develop, indicated by an increase in the temperature, a dry tongue, or delirium, immediate operation is demanded.

Proper drainage is essential to recovery. If there is evidence of the ability of the patient to empty the abscess-cavity by the efforts of coughing and maintain it in this state, then operation may be delayed. If, however, the cavity cannot be evacuated and in consequence remains partly filled with the purulent material, there is great danger of general sepsis, and the sooner an external opening is made the better will be the prognosis. The amount of sputum will generally give a fair idea as to the ability of the patient to empty the cavity, but occasionally the patient will swallow the greater part of his expectoration and so mislead the physician. The physical signs ought, however, to indicate the condition of the abscess-activity. An examination with the fluoroscope will often be useful.

It seems inexcusable to allow a patient to die from abscess of the lung without an effort being made to save his life by means of a surgical operation. As soon as signs of constitutional sepsis manifest themselves, or if there is evidence that the abscess is spreading, immediate operation is demanded. In cases of doubt it seems safer to operate than to trust to spontaneous recovery. Even cases that seem desperate may be rescued by a rapidly completed operation. A number of successful cases have been reported where it seemed



questionable at the moment of operation whether or not the patient was in condition to bear the anæsthetic. The location, nature, and size of the abscess will have some influence in deciding whether or not an operation shall be done. An abscess near the apex is much more likely to drain into the bronchi and heal without operation than one situated near the base of the lung. This must have an important bearing on the decision. When near the base it is well to operate at an early stage of the disease. The chances are that sepsis or pyæmia will result if no external opening be made. It is otherwise with one near the apex. In such cases a certain amount of delay may be safe, but a most careful watch must be kept for constitutional symptoms or extension of the suppurative process.

It is often difficult to differentiate between a pulmonary abscess and an encapsulated empyema which has opened into a bronchus. If in doubt operation is indicated, as, should it be the latter, an external opening is urgently demanded.

The mortality of operations for pulmonary abscesses has been considerable, but in the last few years it has been steadily decreasing, and it will doubtless be still farther reduced now that physicians feel assured that there is a reasonable hope for recovery in any case of pulmonary abscess and an excellent chance for a successful issue provided that the operation can be done before the patient is saturated with sepsis or exhausted by fever. Statistics show that the mortality of operations done within the past three years has been not greater than 25 per cent. In former years it reached as high as 50 or 60 per cent. Trzebicki collected 42 cases which had been subjected to operation prior to 1892. Of these, 14 recovered and 24 died, 3 being improved. Reports of more recent operations are, however, much more favorable, as in the 38 cases collected by Fabricant 29 recovered and 9 died; in the 23 cases collected by Reclus (1885-1895) there were 20 cures and only 3 deaths, and out of 43 patients operated on by Tuffier 35 recovered and 10 died.

"The nature of the primary disease plays a great part in determining the course of events: 17 cases of abscess after fibrinous pneumonia gave 14 cures and 3 deaths; 7 after specific fevers gave the following results: typhoid, 2 cases, both cured; scarlet fever, 1 case, which died; pyæmia, 4 cases, 3 cures, 1 death; suppurating hydatid cyst, 3 cases, all cured; bullet-wound, 2 cases, both cured. Pneumonia is therefore the commonest cause of abscess of the lung, and operation on abscesses of this character is in the great majority of instances crowned with success" (Reclus). Another quotation from the same author well expresses the views of many surgeons and physicians: ". . . and may now assert that whenever there is an abscess there ought to be an operation. No need to wait till fever

blazes up, till the patient is threatened with septic absorption and his general condition is alarming; one has no right to delay, save perhaps in a case where the abscess is very small, draining easily and readily into the air-passages, or where there are multiple abscesses requiring for their evacuation such mangling of the chest as would not be justified. Happily these latter cases are rare."

**OPERATION.**—Incision into pulmonary cavities was advised as long ago as 1710 by Baglivus and others. In 1850 Graux reported 13 unsuccessful cases of operation, and this with other unfavorable reports retarded the progress of thoracic surgery until fifteen or twenty years ago when numerous successful operations on animals raised the hope that similar results might be obtained as the result of intra-thoracic surgery on the human race. Except in cases of abscess, hydatid cysts, and gangrene this expectation has not been realized. In these three conditions, however, the results of operation are very promising.

The existence of adhesions between the lung and chest-wall has been hitherto and unfortunately still is by some surgeons considered a requisite for successful operation. More than one patient's life has been sacrificed on this account. In latter years many successful operations have been performed where there have been no adhesions between lung and chest-wall. While it is not denied that adhesions are of great value, yet they are not essential, and if operation is indicated by the symptoms it should be performed, adhesions or no adhesions.

Before operation it is often difficult to determine whether or not the lung is adherent. The history of previous pain and the existence of friction-sounds in a case where the abscess is not of recent origin is generally an indication that adhesions have already formed.

*Details of Operation.*—The first step is to determine the existence of an abscess and its location. This is best accomplished by means of an exploratory puncture with an aspirating needle. Very possibly, however, this may fail to detect the abscess, as the pus may be too thick to pass through the needle or the cavity may be nearly collapsed. The needle used for this purpose must be a large one, at least four inches long and with a calibre of one to two millimetres. An ordinary hypodermic needle is almost valueless. The syringe must be in good order and possess a powerful suction-force. The small aspirating syringe or the large hypodermic syringe which is used for whiskey may be employed. The needle and syringe must be carefully disinfected according to the rules which will be found in the section on aspiration in pleurisy.

The skin of the patient is thoroughly cleansed by means of scrubbing with soap and water, followed by alcohol or ether and a solution



of bichloride of mercury 1:1000. The probable site of the abscess has been already determined by the physical signs, and the needle is plunged in between the ribs in the direction of the supposed cavity. The abscess, of course, may be adherent and superficial, but generally it is necessary to thrust in the needle for a distance of three and a half to four inches before the cavity is reached.

As soon as the syringe has been introduced it may be determined by the oscillation of the needle that a cavity has been entered. On the other hand, no such sensation may be imparted to the fingers, and on withdrawing the piston no pus may appear in the syringe. The needle should then be removed and inserted at another spot, and so on for three or four punctures until the abscess is found. Even should all the punctures fail to find pus an attempt should still be made to open the abscess by an operation, provided that the symptoms and physical signs point decidedly to its existence. Even should then the cavity not be discovered the abscess may at a later date open into the incision which has been made in its neighborhood.

Considerable information as to the presence or absence of adhesions may be derived from the needle. If a sensation of its passage through thick, tough tissue is felt before it enters a cavity, this probably means the agglutination of the lung to the costal pleura. If, after the needle has entered the cavity, the syringe moves up and down with the respiratory movements, it tends to show that the lung is still unattached. If no such motion occurs it is probable that adhesions exist.

The presence and situation of the abscess having been determined, the next step is its evacuation. For this purpose an ample opening should be made in the chest-wall at a point which will afford comfortable access to and free drainage for the cavity. As a rule, some point in the mid-axillary region will be found the most convenient; it may be between the posterior axillary line and the outer edge of the scapula, or between the anterior axillary line and the nipple line, but usually the spot selected will be in the mid-axillary line and between the fourth and eighth ribs. A free incision along the rib should be made at least three and often six inches long. The periosteum of the rib is divided, pushed aside with a periosteotome for a space of three to four inches, and that portion of the rib excised with a costotome (bone-forceps). This may give sufficient space, especially if the lung is adherent, but often it will be better to remove a corresponding portion of the rib above or below, and especially is this necessary where no adhesions exist and if an attempt is to be made to shut off the pleural cavity from contact with the contents of the abscess by either gauze-packing or suturing. It must be exceptional where an opening is needed larger than that afforded by the removal of portions



of two ribs, each three or four inches long. It may be necessary, however, in cases where no adhesions exist and where the location of the abscess is uncertain, to remove portions of a third or even fourth rib. There is no disadvantage in a large opening, and it may be of distinct advantage if the lung at a later date refuses to expand sufficiently to fill the pleural cavity.

First will be described the method of procedure when the lung is adherent to the costal pleura. As a rule, in such cases the abscess is comparatively superficial and the danger of hæmorrhage is slight. The pleural layers are seen to be thickened, whitish in color, and generally firmly agglutinated. The incision into the abscess can be made without fear of infecting the pleural cavity. It may be opened by knife, scissors, trocar and canula, or cautery. The instrument employed will depend on the individual preference of the surgeon as well as on the location of the abscess. Prior to the incision, however, the operating needle should be again inserted, and, after pus has been found, should be left *in situ* in order to serve as a guide to the abscess-cavity. Indeed, in adherent cases the needle which found the pus before the chest-wall was opened can be left *in situ*, but in non-adherent cases this is inadvisable. With the needle as a guide the knife, scissors, or cautery slowly cuts or bores through both layers of pleura and through lung until the cavity is entered, when the pus runs out—it may be an ounce or so, it may be half a pint or even more. An opening large enough to permit of easy entrance of the finger should be made. As a rule the hæmorrhage is but slight, especially if the cautery has been used, but even after the knife or scissors it is not alarming, at least so far as actual loss of blood is concerned. If the bleeding is free it may be wise to plug the opening at once with gauze to prevent the entrance of blood into the air-passages. On account of this danger the best instrument for making the incision into the lung is probably the Paquelin cautery, at least if the abscess is deeply situated. The finger is then passed into the cavity and gently swept around, breaking up the friable bands and removing sloughing tissue. Care must be taken not to tear apart bands of any considerable thickness, as in them may be blood-vessels of some size. Careful palpation with the finger in the interior of the cavity should then be made for the purpose of ascertaining if there be secondary abscess. Should soft spots be discovered these must be punctured by finger, scissors, or cautery, so that free drainage into the original cavity may be afforded.

The interior of the cavity should be gently swabbed with bits of sterile gauze on the end of long forceps. No irrigation should be employed. This, at least, is a good rule, as there is danger of drowning the patient with the irrigating fluid, and it certainly should never

be employed as long as the patient is fully under the influence of an anæsthetic.

After cleansing the cavity it should be drained by a large soft-rubber tube and by strips of gauze (iodoform or sterile) passed into the cavity and brought out through the opening in the chest.

Second—when the lung is found not adherent to the costal pleura. If, after opening the chest-wall, the lung is seen to move upward and downward with inspiration and expiration, adhesions do not exist and the procedure just described must be modified. That plan is safest whereby the operation is completed in two stages. The older surgeons advised the employment of caustics which were placed in the pleural cavity and allowed to remain for a few days until sufficient inflammation had been excited to cause adhesions between the pleural layers. This, however, is an uncertain and clumsy method. A much safer plan is, after making a large opening by the excision of portions of two ribs, to strip the parietal pleura from off the chest-wall for a considerable distance around the opening so that there may be a considerable area of free parietal pleura which can be sutured to the visceral layer.

The pleural cavity is then cautiously opened and the lung quickly seized, before it has collapsed, with forceps, and while thus held the flap of the parietal pleura is sutured to the lung with catgut carried in a curved needle. If the incision into the abscess can be delayed for a few days, a few sutures will suffice, gauze being packed around the line of suture. If, however, it is necessary to open at once—and this is generally the case—the two layers of pleura should be, if practicable, accurately approximated by a continuous suture running entirely around that portion of the lung into which the incision is to be made. In this manner the pleural cavity is completely shut off from danger of contact with the abscess-contents. Serous membranes unite quickly, and after a delay of even twenty-four hours sufficiently firm adhesions may have formed to allow of an incision into the cavity without danger of exciting a pyo-pneumothorax. Of course this means a second operation, but the incision into the abscess-cavity can often be made without an anæsthetic, or perhaps with the aid of a few whiffs of chloroform. It is rare that a longer delay than twenty-four hours is advisable, though if it be possible to wait three or four days the adhesions will be more secure. As stated, however, the abscess must generally be opened at once, and thus no opportunity be given for the formation of adhesions. In many cases it will be found exceedingly difficult and sometimes impossible to unite by suture the two layers of pleura, as the lung may be contracted and adherent to the internal wall of the pleural cavity. In many others the condition of the patient will demand a rapid completion of the operation and will not allow of the

time needed for the application of the suture. Under these circumstances the pleural cavity must be protected by gauze compresses and sponges from contact with the pus.

If the pleural cavity should, during the operation, have become infected, it is perhaps wise to make a second opening near its base and insert a tube for drainage and irrigation.

The external dressing, which ought to be abundant, will probably be thoroughly saturated in twenty-four hours and should be changed. The gauze with which the abscess-cavity was packed should, as a rule, not be removed for at least forty-eight hours or longer. There will generally be considerable foetor and it is wise in this case to gently irrigate the abscess-cavity with salt solution, and if necessary the pleural cavity as well. The dressing after this, for a time at least, should be removed every twenty-four hours. The cavity usually closes rapidly, and the packing and tubes can soon be dispensed with.

Hæmorrhage after operation, both from the wound and through the bronchi, is often a troublesome and sometimes a dangerous complication. The treatment should consist of absolute rest with perhaps inhalations of oxygen, and ice on the chest and by the mouth. These hæmorrhages, however, are apt to continue until the sloughs have been cast off.

If the shock of operation has not been too great the patient ought slowly to improve, though, as a rule, convalescence is tedious. Food and stimulants in abundance, and tonics, with perhaps oxygen, should be given. As soon as the strength will permit an out-door life in a balmy climate should be chosen.

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### GANGRENE OF THE LUNG.

**Etiology.**—In considering the etiology of gangrene of the lung it is convenient to recognize two varieties of the gangrenous process—one the so-called “embolic gangrene,” where a putrid embolus is carried by the blood-current to the lung and there arrested in one of the terminal arterioles; the other where the gangrenous process is engrafted upon a previously existing lung-lesion.

The bacteria of putrefaction are in all cases the cause of the gangrene. No one specific bacterium has been found. They must have, however, a suitable soil for propagation. This is especially true as regards the gangrene which follows inflammatory conditions of the lung. The air-passages constantly contain these germs, and a suitable culture-bed seems only to be found in individuals whose health has



been undermined by illness, alcoholic excesses, or bad hygienic surroundings. The white blood-cells of such patients seem to be lacking in phagocytic power.

The poisonous embolus may have its origin in a putrid process in any part of the body, a sloughing bed-sore, an osteomyelitis, a malignant endocarditis or a septic process in the female sexual organs. Necrotic areas of suppuration about the thorax, larynx, or œsophagus are a fruitful source of gangrenous emboli on account of the easy access from these parts to the lungs. Indeed, spots of broken-down tissue in any part of the body may be the source of these emboli. As a rule they lodge near the surface of the lung and the affected area is at first wedge-shaped.

Foreign bodies which, entering the larynx, lodge in a bronchus are a not infrequent cause of gangrene. Coins or particles of food which have "gone the wrong way," or have been regurgitated from the stomach, have been recorded as exciting causes. After an accident of this sort a zone of inflammation is gradually set up around the foreign body at the site of its arrest; the putrid bacteria gain access to this area and a certain amount of gangrene of lung-tissue is the result. The prognosis in such cases is not always unfavorable, because the foreign body, released from its position by the disintegration of the surrounding bronchial wall, may be coughed up together with the gangrenous lung-tissue.

Hæmorrhagic spots the result of contusions of the lung or the damaged areas around the track of a bullet or a sharp penetrating instrument may become infected by putrid germs conveyed in the inspired air. The areas of atelectasis in broncho-pneumonia may become similarly infected.

Diabetics seem especially prone to develop gangrene, due to the feeble resisting power of their tissues. Gangrene of the lung is also one of the complications in scorbutus. In the insane the direct cause of the inhalation pneumonia which results in gangrene may often be the paralysis of the muscles of deglutition. This is seen especially in cases of bulbar paralysis.

Fœtid bronchitis is perhaps the most common cause of gangrene. The process spreads from the bronchi to the alveoli, and small portions of the gangrenous lung may be expelled in the expectoration. The differential diagnosis between these two diseases is apt to be very difficult. The fœtid bronchitis is very often the forerunner of gangrene, and the transition from one to the other may be gradual and insidious. The diagnosis "fœtid bronchitis" has doomed more than one patient to death where a timely operation might have been followed by a different result. In fœtid bronchitis there is apt to be a larger amount of thin, watery secretion with a sweetish putrid odor

perhaps lighter in color and less stinking than in gangrene, where the expectoration is inclined to be darker and resemble sloughing broken-down tissue. Too much reliance, however, should not be placed on such distinctions.

The differential diagnosis of gangrene from bronchiectasis or an empyema with a bronchial fistula is also often attended with difficulties.

A tubercular process which has become infected secondarily by the pyogenic bacilli must also be distinguished from gangrene.

In reaching a diagnosis the history of the patient is often of great value. This, with the physical signs and the character of the expectoration will generally lead to a correct diagnosis. The presence of elastic fibres in the sputum ought to exclude bronchiectasis, and when tubercle bacilli are found the diagnosis of pulmonary tuberculosis is reasonably certain. In gangrene there may be almost an entire absence of expectoration, and the stinking breath, with the physical signs, must in such cases suffice for a diagnosis.

The distinction between circumscribed and diffuse gangrene is of great importance both as regards prognosis and treatment. In the circumscribed there may be one or several foci. In diffuse a whole lobe or the whole lung may be affected. The process at first may be circumscribed and later become diffuse. Fortunately the circumscribed form is of more common occurrence than is the diffuse.

**Prognosis.**—A certain number of cases recover without operation. The mortality, however, is at least 75 per cent. The mortality of cases subjected to operation is considerably lower, and doubtless were the patients sent to the surgeon at an earlier date the prognosis would be still less unfavorable. Many patients have been kept under medical treatment until practically all chance for recovery is past, and as a last resort are handed over to the surgeon. What chance can there be for such patients from any method of treatment? In spite of this the operative mortality has been less than 30 per cent. Heydweiller collected 40 cases operated on prior to 1892. Of these 22 recovered, 14 died, and 4 were improved. Reclus reports on 14 cases operated on within the past ten years with only 2 deaths, 11 having been cured and 2 improved. Tuffier has operated on 74 patients; 60 of those recovered.

As in pulmonary abscess the prognosis will vary considerably according to the cause of the gangrene. Take, for example, the statistics collected by Fabricant concerning 26 cases: 6 cases after acute fibrinous pneumonia, 4 cured; 4 after purulent bronchitis, 2 cured, 2 relieved; 1 after inflammation of the mastoid, cured; 2 after foreign body in the air-passages, both died; 2 after bronchiectasis, both died. The prognosis, however, must always be extremely grave. This is due as much to the wretched general condition of these patients

as to the local lesion. While a few cases of undoubted gangrene have recovered without operation there is an element of doubt as to the correctness of the diagnosis in many of the cases reported as cured by medical treatment.

**Treatment of Gangrene of the Lung.**—Much that has been written in the previous section concerning the treatment of pulmonary abscess will apply to gangrene. Attention to the nutrition and proper stimulation of the patient is of prime importance. Balsamic drugs and antiseptic inhalations are also beneficial. When the diagnosis of gangrene has been certainly made, the important question of operative interference will at once arise. In many cases this is, of course, out of the question. When from the start the gangrene is diffuse, involving the greater part of one lung, operation cannot be recommended. In such a case the one indication is to keep the patient as comfortable as possible. In others the general condition or the complicating diseases contraindicate operation.

It is different, however, when the process is circumscribed and the patch is single and comparatively limited in extent. The patient, if young and in fairly good health, may recover without operation, and in such a case it may be advisable to wait, provided there are no signs of general sepsis or of spread of the process. Both these dangers, however, are very great, and it is a question whether or not even in this class of patients early operation would not be the safest plan of treatment. One can never tell when a general sepsis will start up or when a septic embolus may fly to some other vital organ. All may seem to be favorable, and yet in a few hours some irreparable injury has been done.

A number of arguments are advanced why operation should be delayed, the most important, of course, being that the patient may recover without surgical interference. Another is that operation should not be attempted until the stage of consolidation has passed and deliquescence has begun: the answer to this is that in all probability deliquescence has already begun if the diagnosis of gangrene has been made. Another is that one should wait until adhesions between the lung and pleura have formed. Doubtless these adhesions make the outlook much more favorable, but several successful operations have been performed in their absence, and while waiting for their formation the general sepsis may become so advanced as to exclude later operative procedures. Delay may be fatal.

It is a grave question whether or not it would not be wise to advise operation in every case of *circumscribed* gangrene, unless where from the first the general condition of the patient or intercurrent diseases indicate the hopelessness of any form of treatment. On this point medical men are wavering, and surgeons are inclined to advise



more frequent and earlier resort to operative interference. It often, however, seems justifiable to delay operation if the gangrenous patch is small, if the general condition of the patient is good, and if there are no signs of constitutional infection. In patients over fifty such delay, however, seems unwarranted. In any case where operation is postponed a most careful watch for new symptoms or spread of the gangrene must be kept. The patient is on the edge of a precipice, and at any moment a complication may arise which will render the case hopeless.

The operative technique will differ but slightly from that recommended for abscess. The opening should be large, even larger than in cases of abscess. Adhesions are of great advantage, but if not found the pleural cavity must be protected as well as possible. The danger of hæmorrhage is comparatively slight. The incision into the lung is best made by the cauterizer. This should be used very freely and the sloughing portion perforated in many directions and as much of it destroyed by burning as seems safe. As much of the gangrenous lung-tissue should be removed as possible, provided the condition of the patient permits of a prolonged operation. Generally, however, one must be content with a free incision into the gangrenous patch. Thorough drainage and packing the cavity with strips of iodoform or sterile gauze is necessary.

The shock as a rule is not great, and often within forty-eight hours improvement will be noticeable. The packing should be removed at the end of forty-eight hours and the wound carefully cleansed, gentle irrigation with hot salt-solution being employed. A frequent change of dressing, at least once in forty-eight hours, will be necessary for some time. Convalescence is apt to be slow, and a chronic fistula may result which at a later period may necessitate one of the operations of thoracoplasty. All efforts should be directed toward supporting vitality.

An attempt should be made to disinfect the sputum and to keep the mouth as sweet as possible. As long, however, as sloughing tissue remains in the lung the foetid expectoration will continue.

## PERITONITIS, NON-OPERATIVE AND POST-OPERATIVE, APPENDICITIS, PARATYPH-LITIC ABSCESS, AND OBSTRUCTION OF THE BOWELS.

By GEORGE RYERSON FOWLER, M. D.

### PERITONITIS.

INFLAMMATION of the peritoneum is exclusively of septic origin. The disease may be due to direct infection, as, for instance, when the germ comes in contact with the peritoneum; or to indirect infection, in which case the inflammatory affection arises from the presence of certain chemical products, or toxins, which invade the serous membrane through the circulation. In some instances the source of the infection is obscure. When the effused products of the inflammation prove to be apparently sterile, the failure to isolate and cultivate the germ may be due to the fact that the latter is destroyed by the macrophages of Metschnikoff, or that the particular micro-organism present is of a variety impossible of cultivation by any of the known methods of culture.

The peritoneum is an enormous lymph sac, and therefore peritonitis may be considered as a lymphangitis. The peritoneal absorbents are represented by lymphatics in the structure of the peritoneum, and infection and consequent inflammation of these, leading to peritoneal exudates and thrombo-lymphagites, seal these against absorption of septic material from the peritoneal cavity, and hence conserve the safety of the organism and saves the subject from rapid death.

For clinical purposes the peritoneum may be divided into three areas, namely, the diaphragmatic, the enteronic or intestinal, and the pelvic. The importance of this distinction resides in the fact that the lymph channels in the first-named are larger and numerous, with comparatively larger openings, or stomata; in the second, or intestinal area, the lymph trunks and stomata are less numerous; while in the third, or pelvic area, the peritoneum is rich in capillary lymphatics, but larger lymph channels and stomata are conspicuously absent. Hence, it follows that the readiness with which infection of these separate areas takes place produces alarming conditions in the system at large

will vary. Septic inflammatory conditions in the diaphragmatic area, particularly in its central or tendinous portion, where the lymph trunks and stomata are especially numerous and larger, will lead to rapid absorption of septic material, for the reason that the coincident lymphangitis and formation of lymph-thrombi and fibrino-plastic exudate occur comparatively slowly, thus affording opportunity for overwhelming the system at large through rapid absorption of micro-organisms, toxins, and sepsis-bearing endothelial debris from the peritoneal surfaces before the formation of proper protection barriers in the lymph trunks and stomata is effected. The same remarks hold good, save to a less degree, in considering the intestinal area. Here the conditions favoring rapid absorption, while less threatening than those which exist in the diaphragmatic area, are still sufficiently so to constitute this a dangerous area as a whole. Like those of the diaphragm, not all portions offer equal facilities for rapid absorption. The neighborhood of the root of the mesentery of the small intestine may be considered the most dangerous, and the portions to the outer sides of the colon as the least dangerous.

Reasoning from the same anatomical and physiological data, this being likewise supported by clinical experience, it is found that, owing to the comparatively small size of the lymph vessels in the pelvic area of the peritoneum, and the consequent readiness with which these are sealed by lymph-thrombi and coincident pressure from without from peri- and para-lymphangitis, the presence of septic inflammatory conditions in this area of themselves menace life scarcely at all as an immediate effect of their presence, and as compared to similar conditions as they exist in the two other areas.

From the anatomico-physiological standpoint, therefore, peritonitis as it involves the diaphragmatic area is a most dangerous lesion; involvement of the intestinal area is less so; and that of the pelvic peritoneum least of all. Clinical evidence supports this view.

For convenience of study the disease may be divided into—(1) Perforative Peritonitis; (2) Infectious Peritonitis; (3) Symptomatic Peritonitis; (4) Tubercular Peritonitis; (5) Peritonitis due to Undetermined Infections.

**Perforative Peritonitis.**—In this variety the infection has its origin in the intestinal canal. By far the greater number of cases of peritonitis have their origin in this manner. The lesion of the intestinal canal may involve necrosis of its walls, as in ulcerative lesions, or the germ may pass through the intestinal wall without actual loss of substance of the latter, as when, for instance, this is the subject of disease, or is the seat of circulatory disturbances.

The conditions most frequently present in perforative peritonitis in which the infection takes place from loss of substance of the intes-



PLATE V.



The Progressive Steps of the Operative Technique  
of Appendicitis.

The site of the usually-employed oblique incision upon the outer edge of the right rectus muscle. The abdomen is entered through the right linea semilunaris.



PLATE VI.



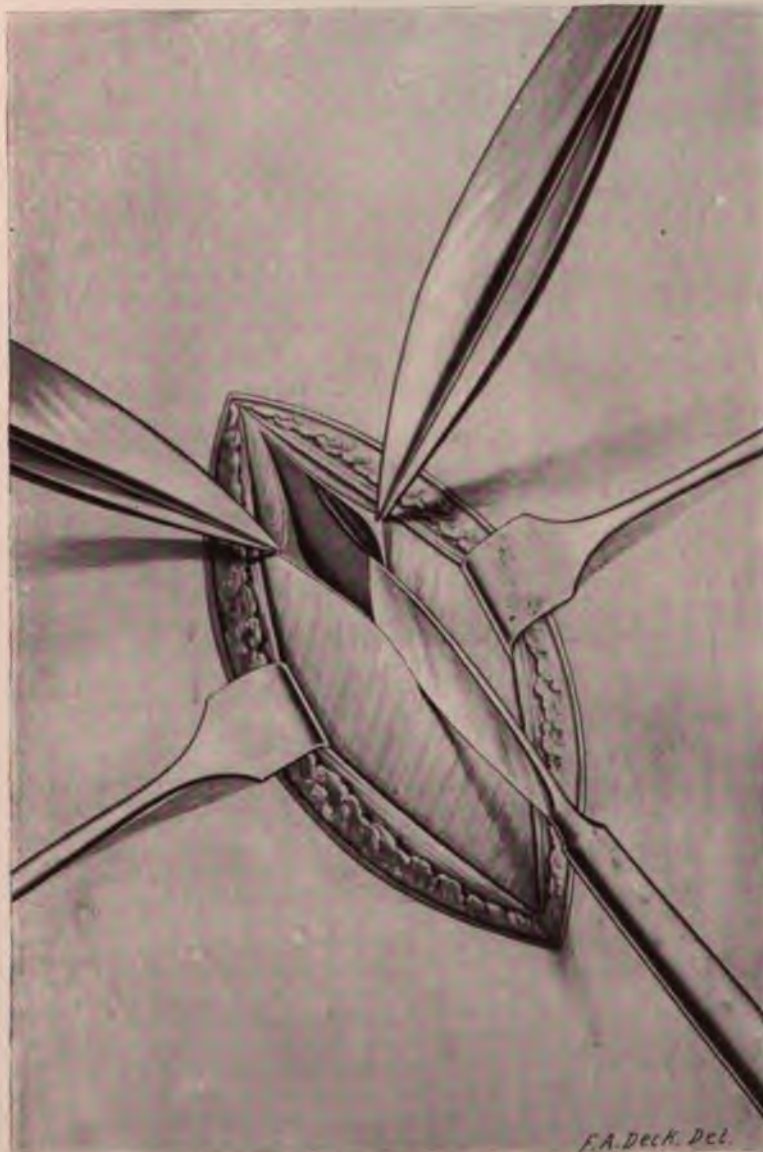
The Progressive Steps of the Operative Technique  
of Appendicitis.

The aponeurosis of the external oblique is exposed, grasped by anatomical forceps, and a small incision made, into which one blade of the forceps is inserted to serve as a guide in completing the incision.





PLATE VII



The Progressive Steps of the Operative Technique  
of Appendicitis.

The internal oblique grasped by two pairs of forceps and the incision in this structure made at the outer edge of the rectus muscle.





PLATE VIII.



The Progressive Steps of the Operative Technique  
of Appendicitis.

The incision of the transversalis fascia and peritoneum with the finger passed through a small opening in these to guard the intestine from injury.

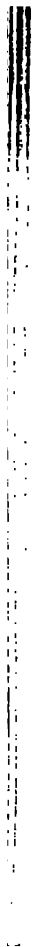
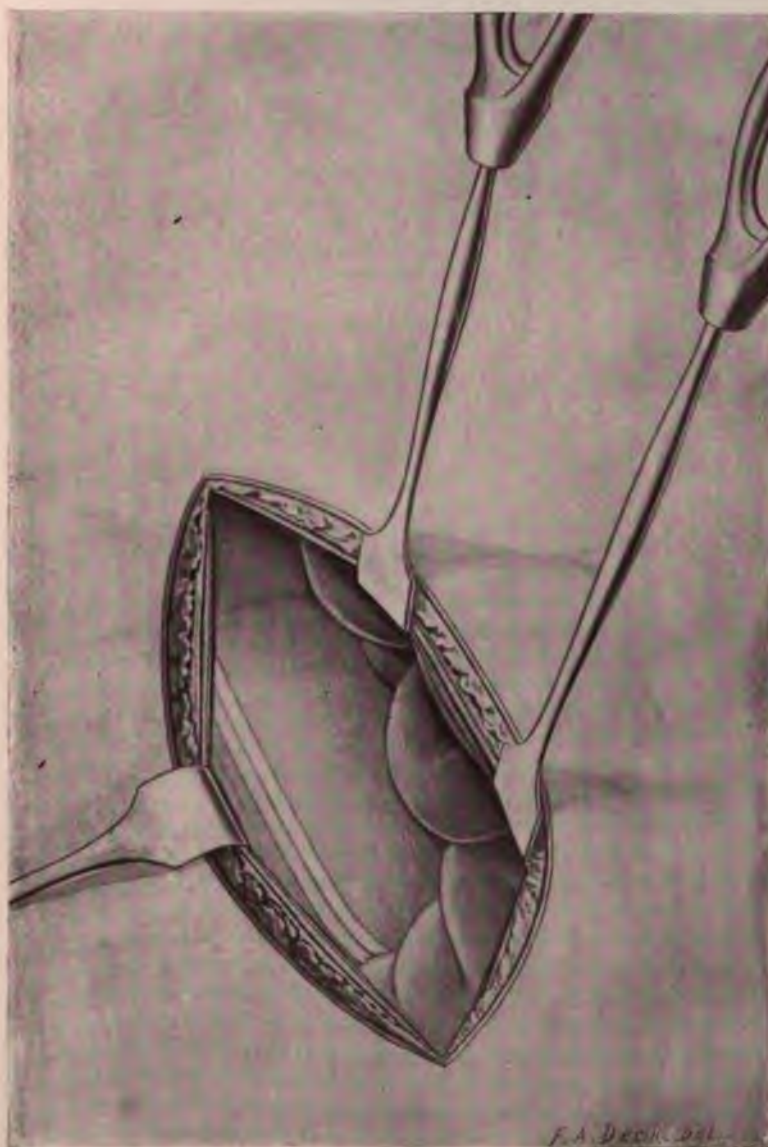


PLATE IX.



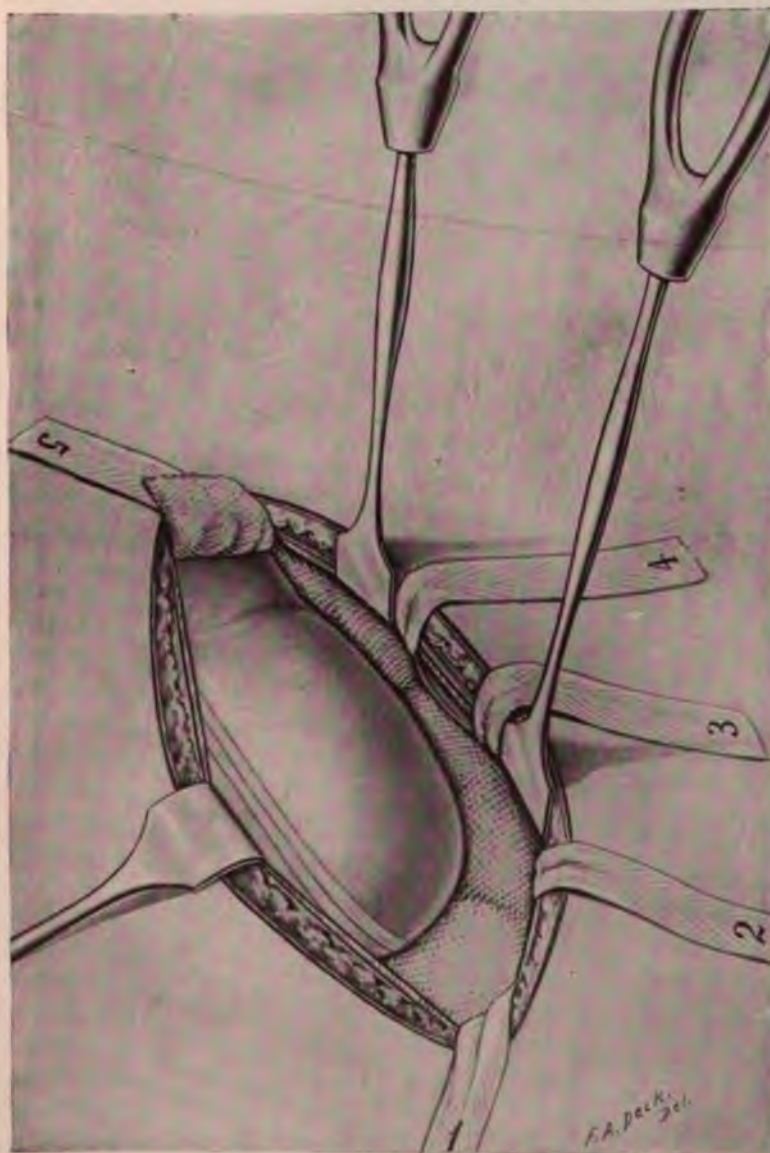
The Progressive Steps of the Operative Technique  
of Appendicitis.

The outer edge of the incision is retracted. Two more retractors are introduced at the inner edge of the incision and the latter drawn inward and forward.





PLATE X.



The Progressive Steps of the Operative Technique  
of Appendicitis.

Compresses or pads of gauze with tapes attached and numbered are packed about the colon and cecum to isolate these from the remainder of the abdominal cavity.





PLATE XI.



The Progressive Steps of the Operative Technique  
of Appendicitis.

The cecum brought into the abdominal wound, and the mesoappendix ligated.



PLATE XII.



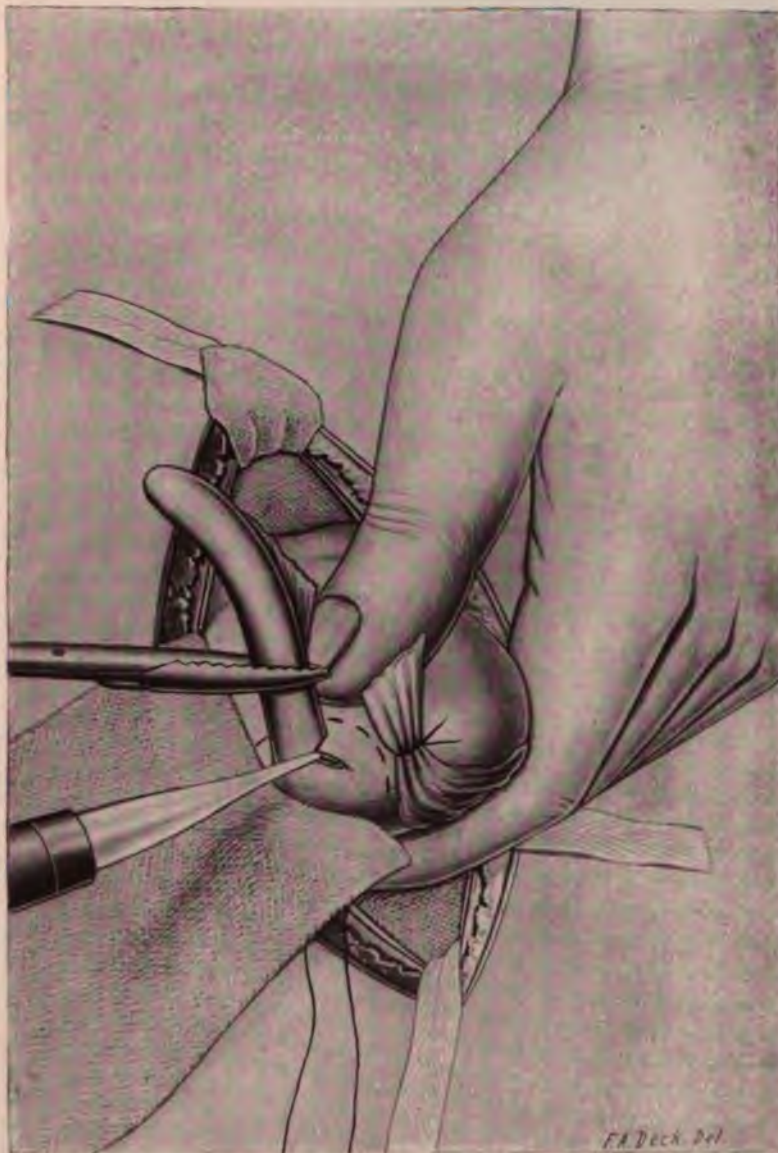
The Progressive Steps of the Operative Technique  
of Appendicitis.

The mesoappendix severed and detached. A purse-string or tobacco-pouch suture is passed through the serosa and muscularis of the cecal wall a half-inch from the base of the appendix.





PLATE XIII.



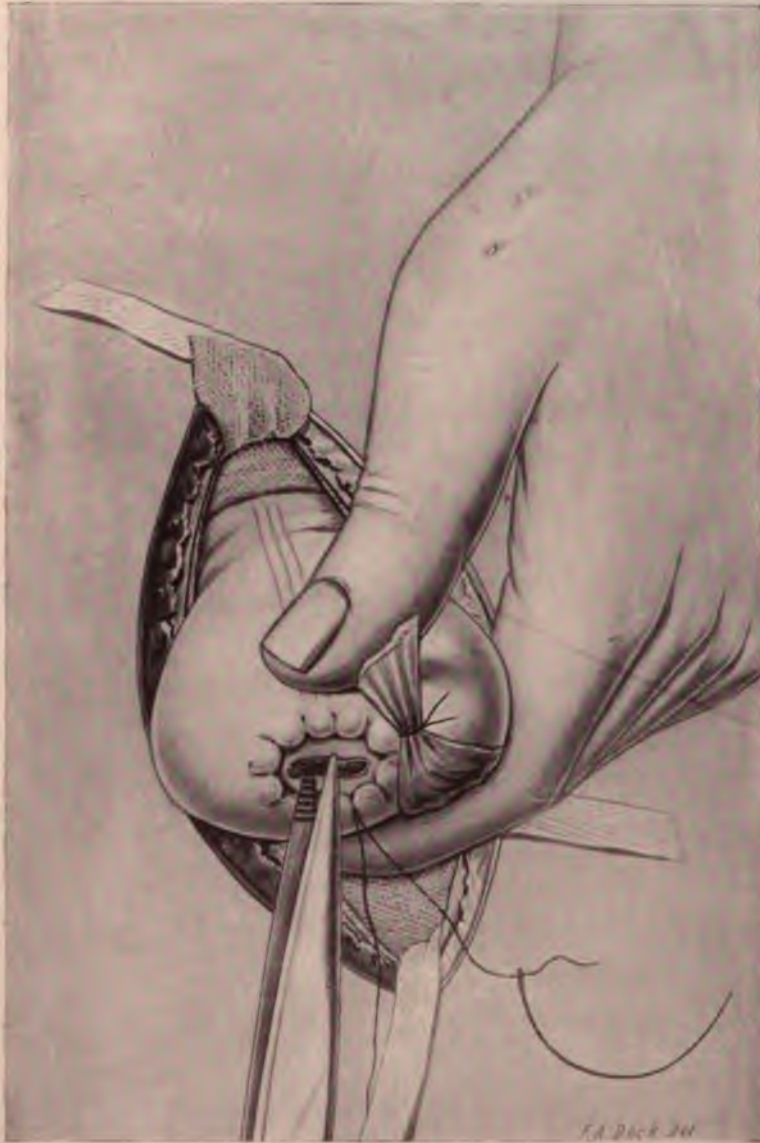
The Progressive Steps of the Operative Technique  
of Appendicitis.

The appendix, together with a small portion of the cecal wall is excised with the thermo-cautery. The appendix is grasped by forceps to prevent escape of its contents, and a gauze compress is placed beneath the cautery point to prevent injury from the head of the latter.





PLATE XIV.

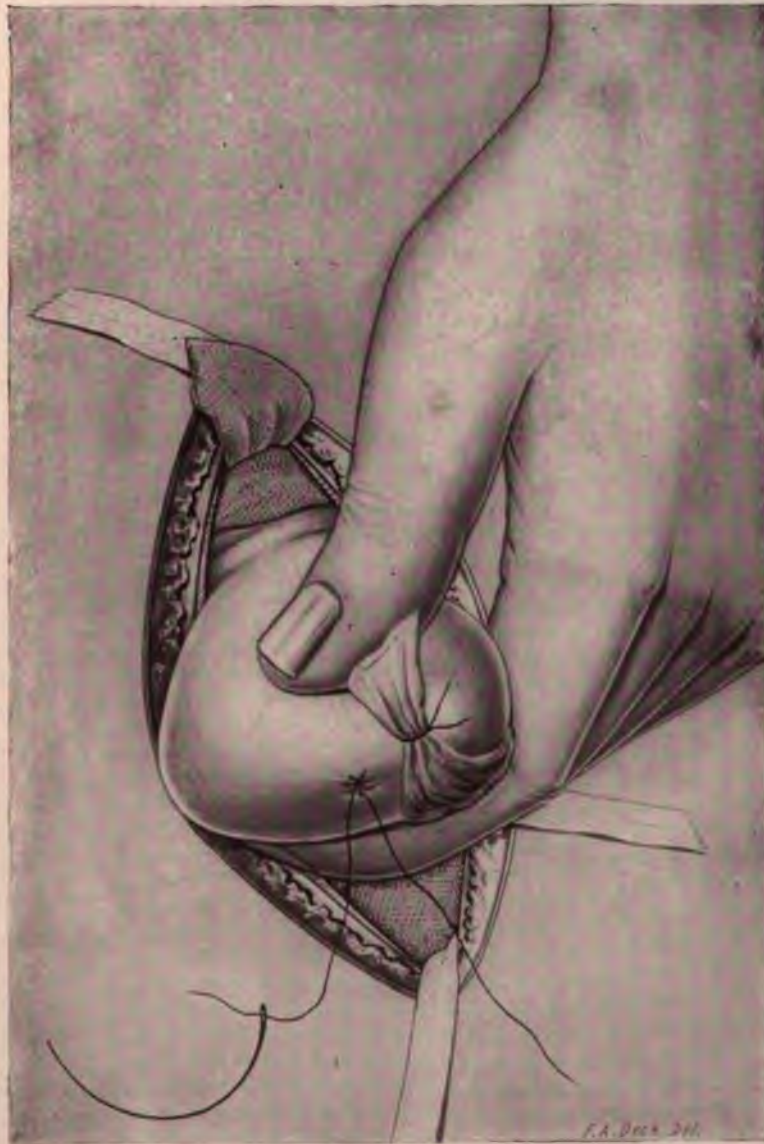


The Progressive Steps of the Operative Technique  
of Appendicitis.

The edges of the opening in the cecum are grasped by forceps and the cecal wall inverted as the purse-string suture is drawn taut.



PLATE XV.



The Progressive Steps of the Operative Technique  
of Appendicitis.

The opening in the cecum completely closed by the purse-string suture. The stump of the mesoappendix is made to reinforce the inverted cecal wall by placing it over the site of the latter and tying the ends of the purse-string suture over it.





PLATE XVI.



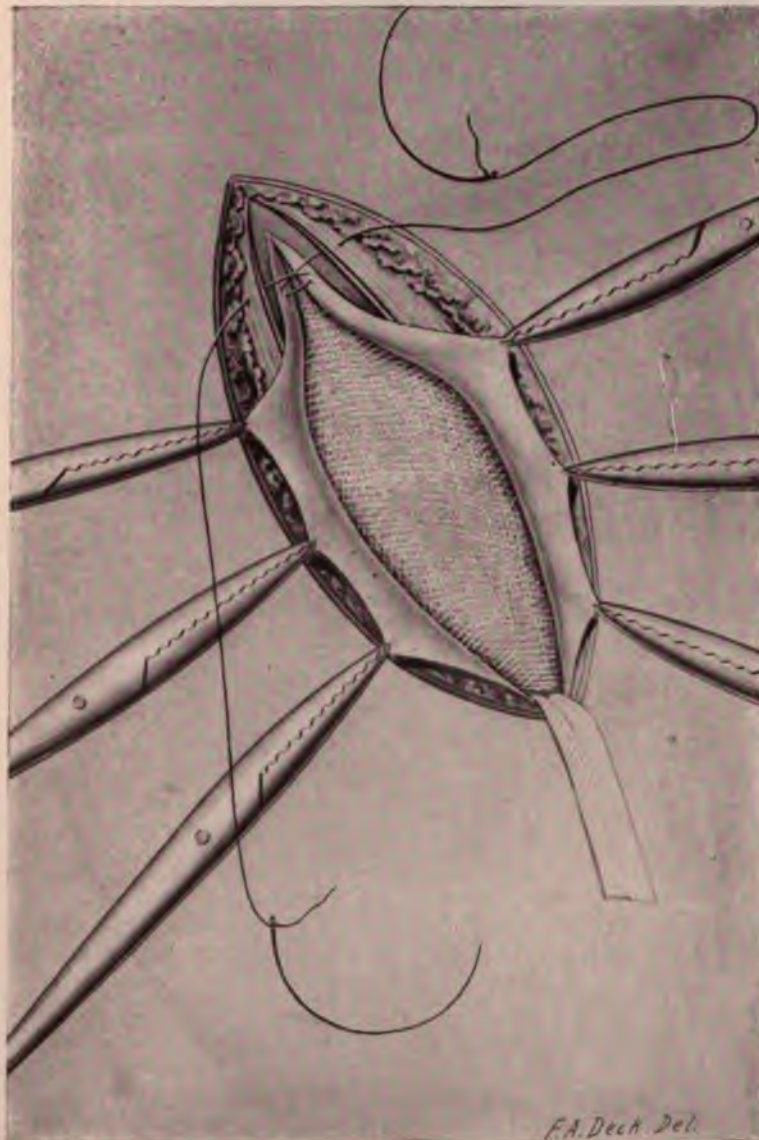
The Progressive Steps of the Operative Technique  
of Appendicitis.

The application of the "crossed" or removable layer suture. A needle upon either end of a strand of silk-worm gut is passed through the peritoneum and transversalis fascia in Lembert suture fashion in order to secure surface, rather than edge-to-edge approximation of the latter.

1  
2  
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1  
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PLATE XVII.



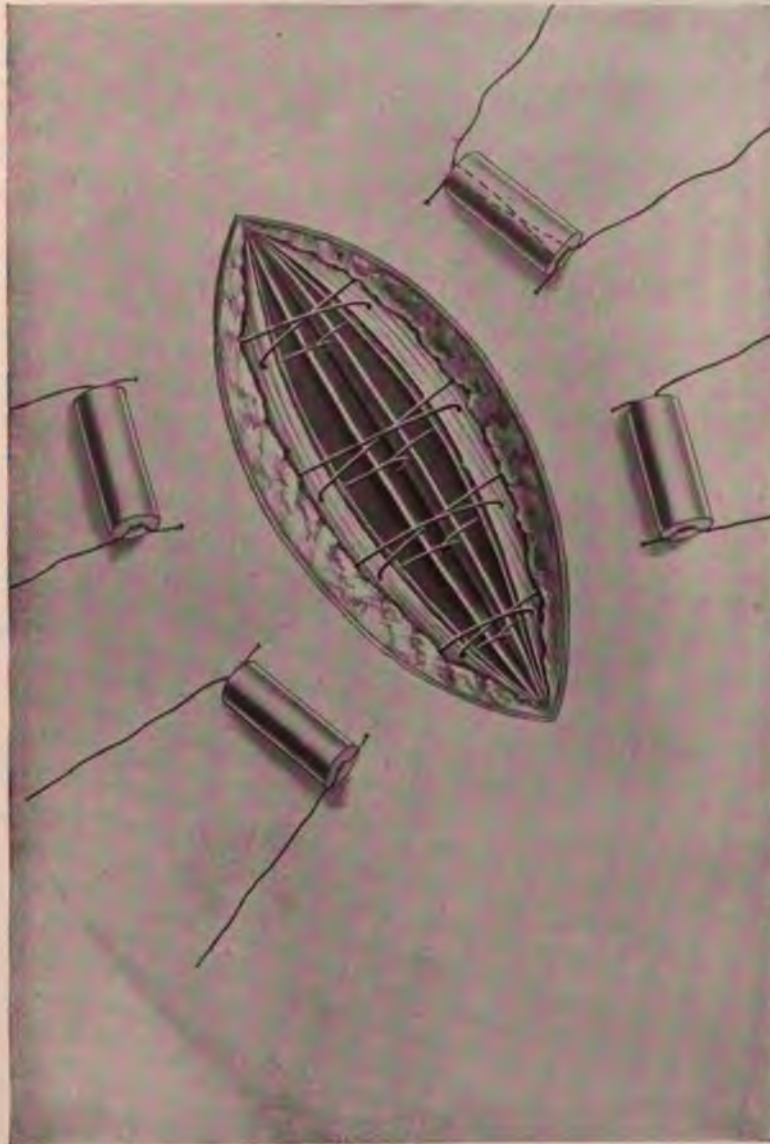
The Progressive Steps of the Operative Technique  
of Appendicitis.

After securing the peritoneum the positions of the needles are reversed and passed through the musculo-aponeurotic layers of the abdominal wall.





PLATE XVIII.

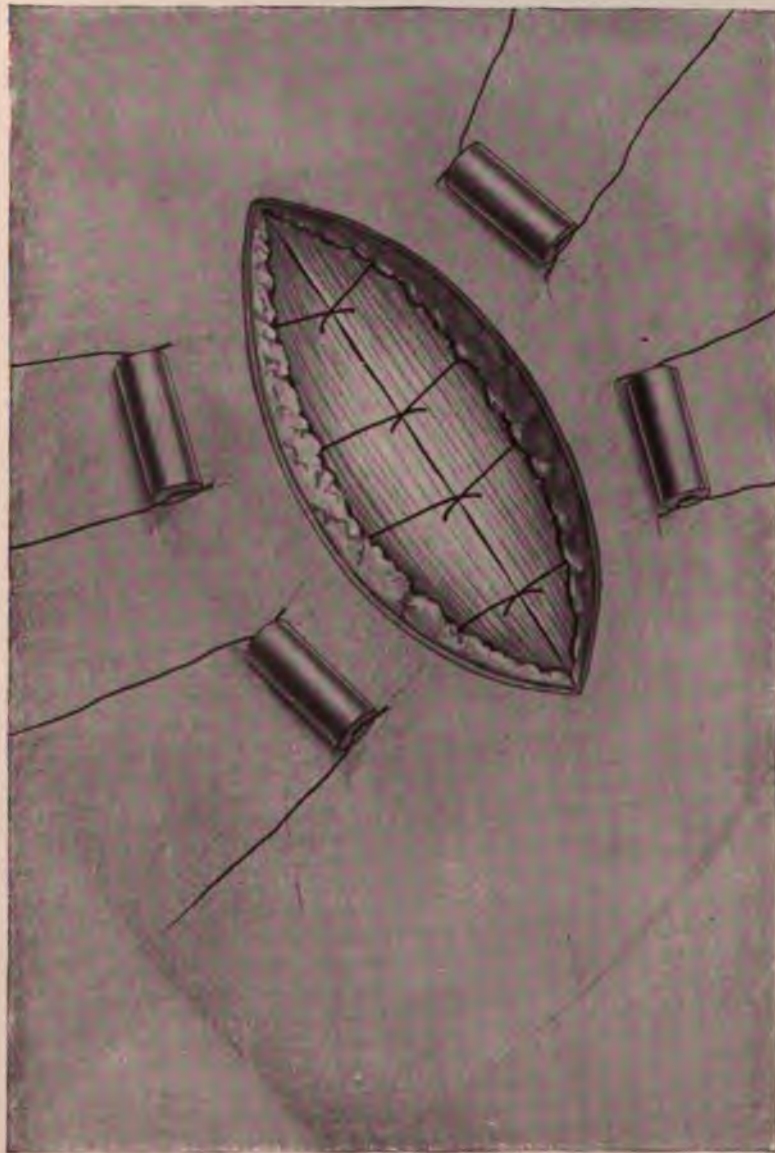


The Progressive Steps of the Operative Technique of Appendicitis.

The positions of the needles are again reversed and passed through the skin. All the abdominal layers are now included in the sutures. The latter are arranged in pairs and each pair threaded upon the lumen of a piece of thick-walled or aspirator rubber tubing. The dotted lines in the upper right-hand tubing or "bolster" shows the manner of passing the silk-worm gut through the lumen of the tubing.



PLATE XIX.



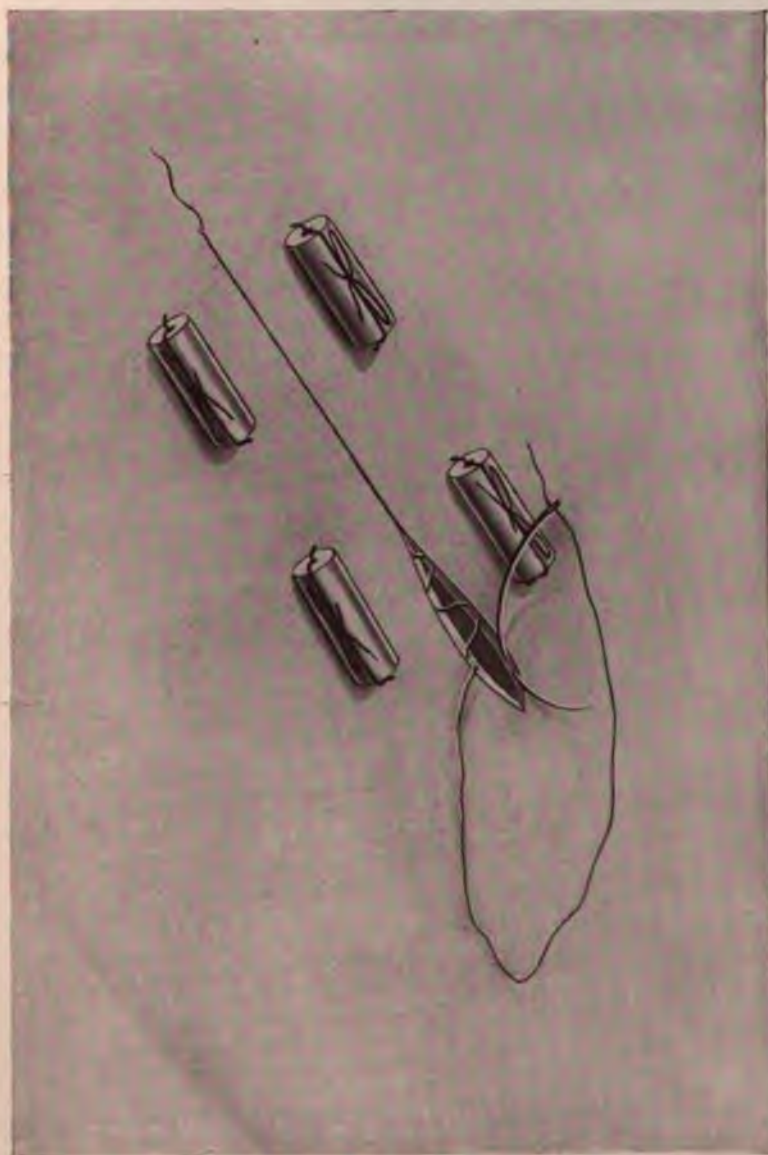
The Progressive Steps of the Operative Technique  
of Appendicitis.

The appearance presented by the parts as the sutures are drawn taut.





PLATE XX.



The Progressive Steps of the Operative Technique  
of Appendicitis.

The sutures tied over the bolsters and the skin-edges in course approximation by means of the intracuticular suture. The edges of the skin sometimes face together, upon tightening the crossed or removable layer suture, sufficiently to dispense with the intracuticular suture.

1. The first part of the document is a list of names and addresses of the members of the committee.

tinal wall are acute appendicitis, typhoid ulceration, foreign bodies, penetrating wounds, and gangrenous conditions resulting from intestinal obstruction. In the absence of ulcerative, penetrative, and gangrenous lesions the infection may be due to conditions giving rise to enervating disturbances, such as internal strangulation, strangulated hernia, intussusception, obstructions by twists, mesenteric embolism and thrombus, and in excessive handling of the intestines during operations involving the opening of the abdominal cavity. Blows upon the abdominal surface may likewise give rise to the disease.

In these cases the germ most frequently found is the *bacterium coli communis*. The almost constant presence of this germ may be due not so much to the fact that it is alone the cause of the peritonitis, but because it is the most common and abundant infectious agent in this locality under normal conditions, constituting as it does about 95 per cent. of all the germs found in the intestinal canal; and for the further reason that this micro-organism possesses such rapid powers of reproduction that other microbes are crowded out of existence by its growth, or at all events their identification is rendered impossible.

**Infectious Peritonitis.**—In this variety the inflammation of the peritoneum is caused by extension of infection from pre-existing septic foci or sources of infection either within the abdominal cavity or adjacent to the peritoneum, such as the rupture of abscesses, or the extension of infectious inflammation from the genital tract. It is the variety present following imperfect asepsis in operative procedures involving exposure and contamination of the peritoneal surfaces. In this variety the common pus-organisms, viz., the streptococcus and staphylococci, are present. The staphylococci are also frequently found, but usually in conjunction with other organisms. Although some forms of the staphylococci are occasionally found to possess a virulence almost if not quite equal to that of the streptococcus or of the colon bacillus, as a rule the infectious inflammation following exposure to the former, or more common pus-cocci, is neither so rapid in its development and course nor so fatal in its results as that which follows streptococcus infection.

Erysipelatous infection in other and remoter portions of the body, as for instance in facial erysipelas, depending as it does upon the presence of the streptococcus, occasionally gives rise to a streptococcus infection of the peritoneum. Under these circumstances the infection undoubtedly takes place through the circulation.

**Symptomatic Peritonitis.**—An acute peritonitis may occur in the course of an acute or chronic disease which itself is dependent upon a specific germ. Of these pneumonia and pleurisy are the most frequent. The pneumococcus is the germ most frequently found under

these circumstances. The presence of this micro-organism has been frequently demonstrated in the peritoneal cavity in fatal cases of pneumonia, although it does not seem to have always produced peritonitis. On the other hand abundant and apparently indubitable evidence has been obtained proving that the peritonitis occurring in the course of pneumonia has been due to the presence of the pneumococcus. Cases of peritonitis in which this germ has been obtained in pure culture have been recorded. In the majority of these instances of pneumococcus infection either pneumonia or pleurisy was present.

**Tubercular Peritonitis.**—This is most commonly secondary and due to extension of infection from the intestines, the genital organs particularly the reproductive organs in the female, and the mesenteric and retro-peritoneal glands; or it may follow tubercular affections of the pleura and lungs. It may occasionally occur as a primary disease of the peritoneum.

According to Aldibert, the ascitic, the fibrous, and the ulcerative forms are to be distinguished. The first mentioned, as its name implies, is accompanied by a large amount of simple, non-purulent ascitic fluid, in which the intestines float about freely, owing to the absence of strong adhesions. The process is usually a subacute or chronic one. It occurs, although rarely, as an acute miliary tuberculosis of the whole peritoneum. In the fibrous form ascites may be present, but it is not abundant. In cases unaccompanied by ascitic fluid, the so-called "dry variety," neither ascites nor adhesions are present. Large tubercles are found here and there upon the peritoneal surfaces. In still another variety of the fibrous form of tubercular peritonitis the coils of intestine are matted together in a mass by adhesions. The fibrous form of the disease has been regarded as a stage in the process of recovery. In the ulcerative form the tubercular foci break down and tissue-necrosis is the prominent feature. In the first stage there is no suppuration, the process being essentially a dry one. Later suppurative changes take place, these being either isolated or encysted, in which case the different stages of the necrosis may be present in different portions of the peritoneum, or the suppurative process may be general.

**Undetermined Infections.**—Peritonitis may occur in the course of syphilis, rheumatism, and gonorrhœa. Here the inflammation depends upon some indefinite infection. In many of these cases the presence of a definite infecting germ has not been made out, although it may be suspected. In this form of the disease may also be included the peritonitis of the new-born, although in this class of cases it is not always possible to exclude infection arising during the separation of the umbilical cord.

In spite of the now generally received opinion that peritonitis



always of septic origin, the contention occasionally arises that a simple, general, and non-infecting peritonitis is possible, and that it does occur. Cases in which the abdomen has been opened with a successful result in the course of general sero-purulent and purulent peritonitis, and in which attempts to obtain cultures have failed, have been reported. Cases of so-called "chemical peritonitis," in which all the signs of peritonitis were present and demonstrable at the operation, but with absolutely sterile cultures, in strangulated hernia, are likewise reported. Admitting the reliability of the technique employed in the bacteriological investigation, it may still be stated that either the now well demonstrated anti-bacterial action of the effused serum within certain limits has been exerted or that there are present micro-organisms possessing sufficient virulence to produce the disease, and for which proper culture-media have not been discovered.

#### SYMPTOMS AND COURSE OF PERITONITIS.

The onset of peritonitis depends largely upon the virulence of the infecting agent and the rapidity of the invasion of the peritoneum. In perforative peritonitis, as well as in infectious peritonitis from the rupture of a large abscess into the cavity of the peritoneum, the rapid dissemination of the infectious material over the large serous surface gives rise to proportional symptoms of shock, rapidly followed by general collapse. Inflammations which extend slowly from a small septic focus, on the other hand, are not attended by shock. Pain is an early symptom, which also varies, both in its severity and persistence, with the virulence of the infection and the rapidity of its extravasation. It may be absent altogether. Both pain and tenderness may be at first localized, subsequently becoming general. Nausea and vomiting are almost invariably present and follow rapidly upon the onset of the disease, the vomited contents of the stomach being soon followed by bile, and finally, in fatal cases, by material from the small intestine, which is ejected without apparent effort by regurgitation. Hæmorrhage from the mucous membrane may occur, in which case the vomitus is of a dark-brown color.

Symptoms of septic absorption set in early in unfavorable cases, as evidenced by a rapid rise in the pulse-rate from 120 to 160; exceptionally it may be less than 100 to the minute. The temperature observations may show this to be excessively high, unaffected, or even below the normal. The intellect generally remains unimpaired to the end. The slow development of the disease is accompanied by only moderate disturbances of pulse and temperature. Chill, as a rule, is absent.

Paralysis of peristalsis occurs early, as a rule, in extensive infection, and symptoms of acute obstruction result, with, save in excep-

tional cases, absence of the gurgling sounds of peristalsis. An excessive distention follows. The skin of the abdominal wall becomes tense, livid, and shining, and resonance is everywhere tympanitic. In cases of mild infection distention may be the first symptom observed. Rigidity of the abdominal wall, localized at first, afterward becoming marked and general with the spread of the inflammation, is an important symptom early in the case; it may disappear with increasing distention. Serous exudation, which finally becomes purulent if the patient survive, occurs. In tubercular peritonitis the only early symptoms in many cases are those which indicate general nutritive disturbances. There are digestive disturbances, progressive emaciation, and some swelling of the abdomen, which, later on, may become extreme. In some instances there may be no pain, while in others this becomes a prominent symptom.

**DIAGNOSIS.**—In typical cases of diffuse peritonitis the diagnosis is comparatively easy. Vomiting, early, persistent, and intractable, is diagnostic, particularly in general infection. The value of pain in diagnosis is frequently overrated and may not be sufficiently prominent to cause complaint. Vomiting, pain, and distention, following rapidly upon each other, form a striking group of symptoms, and if to these be added a brownish-colored regurgitation, the constitutional effects of sepsis, and the occurrence of obstinate constipation, the diagnosis is assured in the great majority of cases. It is nevertheless true that the vomiting may be due to other causes, the pain to efforts at peristalsis, the distention transitory and from gas, and the inability to move the bowels or effect the expulsion of flatus to the administration of opium.

The great variations observed in different cases in the beginning of an attack of peritonitis is due to the variety of micro-organisms upon which the infection depends—these differing, in their turn, in their toxæmic and other properties—as well as to the susceptibility of the individual and the area involved. Later on, however, with the advance of the disease, the symptoms become highly characteristic.

In the differential diagnosis it is of the utmost importance to distinguish between peritonitis and acute intestinal obstruction. Pain, distention, vomiting, and constipation may be present in both conditions. The vomiting, however, may be absent until late in the case if the obstruction is in the large intestine. The occurrence of obstruction above the ileo-cæcal valve may permit of one or two movements of the bowels, and in rare cases fecal evacuations may be obtained throughout the entire course of acute peritonitis. As a rule, however, constipation is complete in both conditions. The character of the pain is important. In acute obstruction it occurs as a severe and paroxysmal symptom, while in peritonitis it is, as a rule, both severe



and persistent. Its primary location, in obstruction, is frequently referred to the seat of the lesion, while in peritonitis it is most often observed in the epigastrium or about the umbilicus, and becomes general later. In both conditions the pulse, as a rule, becomes accelerated. The temperature is not elevated in the commencement of intestinal obstruction; it may rise comparatively early in peritonitis. The onset of the attack in obstruction is generally sudden, while peritonitis, particularly in the less fulminating cases, occurs more gradually.

The differential diagnosis is particularly as between perforative peritonitis and acute obstruction, as well as in cases in which the two conditions are combined. The latter is especially striking for the reason that all cases of obstruction tend to eventuate in peritonitis, and with the early masking of the symptoms by opium nothing short of opening the abdomen, which should be done in all doubtful cases, will clear up the diagnosis. Finally, the previous history of the patient, the occurrence of former attacks of an intra-abdominal inflammatory character to account for intestinal obstruction, as well as the possibilities of appendicitis, ambulatory typhoid, suppurative diseases of the adnexa in females, and purulent collections or infectious conditions in neighboring organs, as well as statements regarding the reception of injuries, are to be taken into account.

In tubercular peritonitis the cases unaccompanied by pain, and before the occurrence of ascites and pronounced abdominal swelling, should be carefully differentiated from typhoid fever. Cases in which the disease attacks the mesentery, the lymphatic glandular structures, and the omentum, without ascites, simulate tumors of the kidney, peritoneal cancer, appendicular abscesses, intestinal obstruction, adnexitis, and even neoplasms in the abdominal wall. In the ascitic form ovarian, mesenteric, and hepatic cysts are to be excluded. The diagnosis is most frequently made by exploratory incision. In typhoid perforation the accident may occur at any time in the course of the disease. It is most frequently observed in males, and rarely in children. Save for the coexistence of the typhoid fever, peritonitis from this cause does not differ from that resulting from other intestinal perforations.

**PROGNOSIS.**—The occurrence of early shock and collapse stamp the case as almost necessarily fatal from the commencement. Severe and persistent pain mark the occurrence of rapid and extensive infection of the peritoneum. Dark-brown or black, coffee-colored vomited matter is almost invariably followed by death. Even vomiting without effort or simple regurgitation is to be viewed as a bad omen. Death may take place from early and rapid septic absorption. A rapid rise of the pulse to 120, 140, and 160 is significant

of an early fatal termination. High temperature is always an unfavorable sign, although the reverse does not hold true. Very slight hope of recovery can be entertained when the paralysis of peristalsis is complete. Lividity of the skin and also a general "leakage" from the cutaneous surface, are most ominous signs, indicative of a profound sepsis. The character of the pulse, however, indicates the patient's condition with far greater certainty than any other one symptom. If it gradually and persistently increases in frequency and assumes either a gaseous or thready character, an unfavorable prognosis must be given.

On the other hand, if the tenderness and rigidity remain localized, the prognosis is more favorable. The fact that bowel movements can be obtained suggests that the infection is less virulent in character, and hence the outlook better. In favorable cases the vomiting ceases, the pulse-rate becomes slower, and the temperature lessens, until convalescence is established.

Tubercular peritonitis gives the same comparatively unfavorable prognosis as tubercular lesions elsewhere, when treated medically. The outlook is better in cases submitted to surgical operation, about four-fifths recovering. In the non-ascitic form the disease has reached a stage in which it is progressing toward spontaneous cure.

#### TREATMENT.

**MEDICAL TREATMENT.**—In the medical treatment of peritonitis the choice of two methods is open to the practitioner. Before the present views of its etiology were entertained the administration of opium was considered of the greatest importance to restrain active peristalsis, inasmuch as this latter was believed to favor the spread of the inflammation. In addition to this the pain was relieved and, in some instances, the vomiting kept under control. At the present time the opponents of the opium method of treatment claim, and with reason, that opium as formerly employed increases the distention, and prevents the absorption of exudates and the elimination of ptomaines.

With our present knowledge of the septic origin of peritonitis, and the recognition of the fact that the chief danger in the disease consists in the absorption of the toxic products of the septic processes rather than in the spread of the inflammation, measures to provide for an elimination of these products through the intestinal canal form the most rational therapeutic indication. In addition to this, means to facilitate the passage of septic fluids contained in the diaphragmatic and intestinal areas to the pelvic region, where, as has been already stated (page 000), they do comparatively little harm, should be provided by elevating the head of the bedstead from twelve to eighteen inches from the horizontal. Nausea and vomiting are likewise relieved and normal peristalsis favored by this posture. In providing



for free catharsis distention is likewise relieved and absorption of peritoneal exudates favored. The method of intestinal drainage, as it is called, has been the means of saving many lives when instituted early, and is now considered the most rational and efficient of the medical means at our command, particularly when employed early in the disease, before vomiting has become persistent and intractable. Later on in the case, when general peritonitis is fully developed, it is doubtful if cathartics exercise a favorable influence upon the course of the disease. Indeed, it is generally useless to attempt to procure free evacuations by their use, since they frequently fail to act, and only increase the nausea and vomiting and the discomfort of the patient. In the event of the existence of a perforation of the intestinal wall a positive contraindication to their use exists, for the reason that they increase the extravasation of liquid faecal matter into the peritoneal cavity.

Thus it will be seen that both of these methods of treatment find a place in the resources of the practitioner. That by catharsis should be first instituted, with the hope of cutting short the disease in its incipency by promptly relieving the distention and averting paralysis of peristalsis. When the vomiting has become uncontrollable and the distention extreme it is useless to attempt to influence the onward progress of the disease by these means. The patient will reject the cathartic agent almost immediately, and even if it should be retained, the muscular apparatus of the intestinal canal, no longer under the control of its nerve-supply, will refuse to respond in a normal manner. The employment of opium now finds its legitimate place in the case. The object sought is to carry the patient along with the view of protecting his nervous system from the effects of the intense restlessness which is generally present, and incidentally to relieve the pain and control the vomiting. This is accomplished by opium better than by any other drug. As long as there is any hope for the patient the remedy is to be given in small doses frequently repeated, until vomiting is under control or at all events markedly abated. Only too often, however, the general condition of the patient stamps the case as so indubitably hopeless, and the suffering becomes so extreme, that the practitioner seeks refuge in larger doses of opium with the sole view of euthanasia.

The class of cathartics selected, when this method of treatment is applicable to the case in hand, is that known as salines. The one most generally acceptable and efficacious is the sulphate of magnesium, or Epsom salts. This should be given in half-ounce doses, either as a saturated solution, or, what I generally prefer, in just sufficient Vichy to effect the solution of the salt. This may be followed later on, if free catharsis is not obtained, by drachm doses given hourly

until either a decided response to its action results, or it becomes evident by the increase in the nausea and vomiting that it is useless longer to expect it to act. Under circumstances of general infection when only constant regurgitation of the contents of the small intestine follow its use, it should be abandoned and calomel substituted in  $\frac{1}{8}$ -grain doses repeated hourly. This will sometimes produce free catharsis without vomiting, and occasionally exercises a soothing effect upon the stomach itself. The action of these may be supplemented by enemata.

When the indications are such as to impel the attendant to resort to the opium treatment, the hypodermic use of morphine should be employed whenever practicable:  $\frac{1}{2}$ -grain doses given at intervals of from two to three hours act as a stimulant to the nervous system and are sometimes followed by a cessation or diminution of the vomiting and occasionally by an improvement in the general symptoms.

There are certain conditions of peritoneal irritation following abdominal section in which opium becomes of the greatest service. The pain which this condition induces robs the patient of sleep and may bring about symptoms of exhaustion. Hence sufficiently large doses of the drug should be given to allay pain and secure comfortable sleep, as well as bring the vomiting resulting from the use of ether, which is sometimes a very distressing symptom, under control. One or two  $\frac{1}{8}$ -grain doses will usually suffice to fulfil these indications.

In the treatment of post-operative peritonitis much judgment may be displayed by the alert practitioner. With the first evidence of infection, or the commencement of distention, and before the vomiting becomes a prominent symptom, a dose of Epsom salts should be given and efforts made to facilitate the action of the latter, as well as to relieve the threatened tympanites, by the use of enemata.

**SURGICAL TREATMENT.**—The employment of surgical measures of relief sometimes becomes a question of grave importance. It is frequently difficult to state the indications for operative interference, even if the surgeon see the case early, which, as a rule, he does not. When, however, a recognized or suspected focus of infection is present as the starting-point of a peritonitis that has not yet become general, as in cases of appendicitis, suppurative adnexitis, suppurative or gangrenous cholecystitis, gunshot injuries and penetrating stab-wounds, as well as traumatisms inflicted from the direction of the urinary tract, and even in typhoid and duodenal ulcerative perforations and in ruptured abscesses, there can be no question as to his duty, if called before general infection of the peritoneum is at hand: he should open the abdomen promptly, and treat the conditions found upon surgical principles. But unfortunately, even when the spreading infection is due to these causes, valuable time has been lost by ineffi-



cient medical treatment, and surgical aid is invoked only when the time has passed for its successful employment.

Besides the causative lesions above mentioned, there are others which demand surgical treatment, in addition to the benefits to be derived from opening the abdomen and draining the peritoneal cavity. These include intussusception, twists, internal strangulations from bands, and mesenteric thrombosis and embolisms. In all of these there is usually a period of time which elapses between the commencement of the symptoms and the supervention of a general peritonitis, as well as the presence of characteristic symptoms, that will permit of successful surgical interference. Although a strict anatomical diagnosis is not always possible, nor yet the differentiation between a commencing peritoneal infection and a mechanical lesion, still the argument in favor of immediate operation is cogent and the indications are clear. In an acute abdominal condition in which these questions alone remain to be settled, exploratory incision is justified, and frequently demanded, if the case be seen sufficiently early to warrant the undertaking.

Once the indications for opening the abdomen are presented, no delay should occur in instituting operative procedures. When the vomiting has been persistent, and particularly if this has been faecal or faecoloid, the stomach should be washed out preliminarily to the administration of the anæsthetic. In the absence of an exact anatomical diagnosis the median incision will be employed. The appendix vermiformis and gall-bladder in the male, and in addition to these the adnexa in the female, as well as the possibility of typhoid and duodenal perforations, should all be considered in prosecuting the search in non-traumatic cases.

Finally, the surgical treatment of the peritonitis itself is to be considered. This consists of ridding the peritoneal cavity of as much of the septic material present as possible, and of taking measures to care properly for that which may be unavoidably left behind or subsequently developed. The first indication is fulfilled by flushing the peritoneal cavity with large quantities of normal saline solution of a temperature of 110° F. This is to be poured from a large pitcher, gallon after gallon being used, and eventration, with proper precautions against injuring the intestines which are outside the peritoneal cavity, practised, if necessary, to aid in the cleansing process. The normal saline solution, under these circumstances, aside from its cleansing effect, forms a ready means of infusing fluid into the general circulation, and, as shown by Issaëff's experiments, by inciting a rapid and profuse peritoneal leucocytosis, confers peritoneal immunity for a certain length of time.

Following thorough cleansing the intestines are returned to the

peritoneal cavity and drainage provided for. The pelvic cavity should be drained in addition to whatever drains the exigencies of the case demand elsewhere. Following the closure of the abdominal wound the patient is to be placed in the elevated head-and-trunk position by raising the head of the bedstead from twelve to eighteen inches from the horizontal, slipping down in the bed being provided against by a properly secured pillow support beneath the flexed thighs and against the buttocks. The object of this posture is to facilitate drainage into the pelvis, in which locality, as previously stated in the opening pages of this article, septic fluids do comparatively little harm. Further than this, the elevated head-and-trunk posture lessens nausea and vomiting and favors normal peristalsis.

My experience with this postural feature of the treatment of diffuse septic peritonitis since I first introduced it to the notice of the profession has been such that I can unqualifiedly recommend it, not only as a prophylactic and curative measure following abdominal section, but also as a valuable resource in the non-operative treatment of peritonitis.<sup>1</sup>

The general measures of treatment applicable to tubercular lesions elsewhere should be taken advantage of in tubercular peritonitis. A nutritious diet, tonics, and change of air constitute the palliative treatment. Aspiration of the ascitic fluid should give place to free incision and drainage, preferably by gauze and wicking, which is dispensed with in a few days. In the simple ascitic form this should be done early. When the disease exists in an acute miliary form operative interference is inadvisable. There is no advantage to be gained by flushing the peritoneal cavity with water or chemical solutions. In this form (the ascitic) relapses occur in about 10 per cent. of the cases operated upon. In the non-ascitic form exploratory incision may reveal localized collections the evacuation of which may hasten the cure. In cases in which numerous pus-collections are present no permanent improvement is likely to follow the breaking down of these, since probably many are not within reach, and great danger is invited by the manipulations necessary to effect this. Isolated instances of improvement following removal of local and defined tubercular mesenteric and retro-peritoneal lymph-glands are reported (Richardson). Intestinal obstruction dependent upon tubercular infiltration of the bowel-wall should receive the same treatment as that due to cancer. The mortality following incision in the ascitic form of the disease is trifling. The rationale of the method of cure is not known.

In typhoid perforation with general extravasation surgical aid should be invoked early. Perforations from one coil of intestine to another, and even slight extravasations, probably pass unrecognized frequently. With abundant and rapid fecal extravasation, in the

<sup>1</sup> *Medical Record*, New York, April 14, 1900, p. 617.



absence of early and efficient operative interference, death occurs unexceptionally.

Three facts should be borne in mind in connection with the operative treatment of peritonitis occurring in the course of typhoid fever :

1. The peritonitis may be due to causes other than typhoid perforation, such as acute intestinal obstruction, softened infarcts of the spleen, softened glands, abscesses of the bladder-wall, abscesses of gall-bladder, ovarian or hepatic origin, rupture of the spleen, and to extension of inflammations from the adnexa and endometrium (Fitz).
2. More than one perforation may be present in typhoid ulceration.
3. Indubitable evidences of peritonitis may be found with no discoverable local lesion present to account for the inflammation.

### APPENDICITIS. 44.

INFLAMMATION of the vermiform appendix, until recently clinically associated with typhlitis, perityphlitis, and paratyphlitic abscess, is now known to be a distinct affection. The large majority of cases formerly placed to the credit of the above-named affections are now believed to have been instances of appendicular lesions.

At least half of the cases of appendicitis occur in persons under twenty-five years of age ; 80 per cent. occur in males, as against 20 per cent. in females. Its occurrence as the result of traumatism is rare, if we except the presence of faecal matter which may enter the appendix in a semi-fluid state, afterward becoming hardened and producing minute excoriations and abrasions, thus leading to infection of its walls. The supposed seeds of certain fruits which have been found in the appendix were probably, in the large majority of cases, masses of faecal matter which had become moulded into shapes resembling lemon-seeds, cherry-pits, etc., in the lumen of the organ.

Occasionally, however, this same faecal matter has incorporated in it strawberry or raspberry seeds which give a roughened exterior to the mass when drying, and in this manner the latter may assume the rôle of a foreign body. In addition to this a genuine enterolith, made up of calcareous matter and having its origin in the intestine or in the appendix itself may be found in the cavity of the organ and be viewed as bearing an etiological relation to the disease as occurring in the individual case.

In the same category may be included cases in which a gall-stone has passed safely through the ductus communis choledochus and along almost the entire length of the intestinal canal, only to be finally arrested at the appendiculo-caecal orifice, and perhaps find its way into the initial portion of the appendix, owing to a more or less funnel-

shaped form of the organ the result of a persistence of the foetal type of the latter.

In seeking for a plausible reason for the case with which inflammatory conditions may be set up in the appendix vermiformis, due consideration is to be given to the fact that this organ belongs to the class of vestigial organs, or those whose function has passed away, and the vitality of which have become thereby greatly lessened in the course of those changes in structure which precede their final disappearance. Bearing this fact in mind it is not difficult to comprehend how a foreign body, or even dried faecal matter, may easily produce slight abrasions of the surface of the mucous membrane lining the organ and thus initiate the series of nutritive changes which may give rise to infection from within the tube, followed by either gangrene and perforation, or suppuration within peritoneal adhesions, and appendicular abscess.

In the majority of cases, therefore, no foreign body is found, if this term be limited to those bodies which are foreign in the strictest meaning of the term. The ulcerative process which precedes the final escape of the contents of the appendix in cases of perforative appendicitis is due either to direct pressure from desiccated faecal matter, this being increased by the expulsive efforts on the part of the organ to rid itself of the irritating material, or to localized necrotic processes following circulatory disturbances in the course of an accompanying meso-appendicitis (Van Cott).

The infecting micro-organism most frequently found is the *bacillus coli communis*. This micro-organism exists constantly in the lumen of the appendix and also in the exudate in the peritonitis accompanying inflammation of that organ. Other bacteria, such as the *bacillus pyogenes fetidus*, the *diplococcus lancetolatus*, and the common cocci of suppuration, are occasionally found.

#### SYMPTOMS AND COURSE OF APPENDICITIS.

In the great majority of cases an attack of appendicitis is characterized at its onset by the occurrence of acute abdominal pain, such as is usually experienced in an attack of ordinary intestinal colic. The similarity of the onset of the latter affection and appendicitis should always place the practitioner on his guard, and the occurrence of sharp colicky pains serve to direct his attention to the vermiform appendix. The additional fact that the pain is first referred, in a large proportion of cases, to the epigastric or peri-umbilical region, and further, the occurrence of vomiting early in the case and the frequent absence of fever at this stage, serve in even greater degree to mislead the medical attendant.

With the advance of the disease pain is referred to the right iliac

region, and tenderness is found to exist at this point. This tenderness is quite localized at first, and is found most frequently best marked upon the outer edge of the rectus muscle, and slightly above the level of the transverse line extending from the anterior superior spinous process of one to that of the opposite side. It may, however, be found below this line and nearer to Poupart's ligament. In cases of congenital abnormality of location of the cæcum the point of maximum tenderness will be elsewhere. Marked tenderness in the loin may be found in cases in which the retro-peritoneal connective tissue is involved.

The vomiting is not frequently persistent during the initial stage of the disease, and usually ceases with the evacuation of the stomach contents, unless the occurrence of septic general peritonitis causes its return. Nausea alone, in some instances, is complained of.

Rigidity of the right rectus muscle is a marked feature in the majority of cases. This muscular rigidity becomes general in cases of extensive septic peritonitis. The right side of the abdomen may have a bulging appearance due to distention of coils of intestine in the immediate neighborhood of the inflamed appendix.

The temperature and pulse vary in different cases, although they do not by any means bear a constant relation to the gravity of the attack. There may be an almost normal temperature and pulse-rate, and yet ulceration, perforation, and septic peritonitis impending.

Fever may be present at the very commencement, or its appearance may be delayed until the second or even the third day. The mass of adhesions constituting the lesion may become the site of a suppurative process from perforation of the appendix into the adhesions, or infection of these may occur from bacterial migration. This constitutes the so-called appendicular abscess. Sero-purulent collections may occur in addition, beyond the immediate area of the appendix, and even at remote points, from infection through the lymph-channels.

In addition to the clinical picture presented by typical cases, there may occur cases of a subacute character. The practitioner should be on the watch for the sudden onset of violent symptoms in this class. Cases apparently of a mild type, and supposed to be only of the so-called "catarrhal" character, may terminate suddenly and fatally from perforative peritonitis; on the other hand, cases with alarming symptoms may go on to a favorable termination.

With apparent recovery without removal of the appendix the patient may suffer from relapses during the persistence of what is really a chronic relapsing form of the disease. Or, complete recovery may take place, but the patient be subjected to recurrences of the affection.



**DIAGNOSIS.**—The cardinal symptoms of sudden onset, acute abdominal pain referred to the general region of the abdomen rather than to the site of the vermiform appendix, at which place it may appear later on, vomiting, tenderness in the right iliac fossa, and comparative rigidity of the lower portion of the right rectus muscle are the distinguishing features of typical cases. The disease must be carefully differentiated from nephritic colic, cholecystitis, inflammatory diseases of the adnexa in the female, and some of the forms of intestinal obstruction. There is greater danger of overlooking appendicitis than of diagnosing one of these as appendicitis. Stercoral typhlitis is a rare affection compared with appendicitis, and, besides, it lacks the features of acute attack without preceding symptoms. In paratyphlitic abscess operative measures will be required, and it may be impossible to make a diagnosis beforehand. In perforative typhlitis, either from ulceration or foreign body, operative interference will be just as urgently demanded as in appendicitis.

#### TREATMENT.

While the medical attendant is generally first summoned to a patient suffering from appendicitis, the case should be viewed as one most likely to become surgical in character at short notice. Hence the responsibility of the treatment should be shared both by the physician and the surgeon. If the symptoms denote a mild type of the disease the careful use of salines may be permitted in the very commencement. The use of opium is to be avoided if possible prior to making the diagnosis, and even thereafter as much as possible, for the reason that the course of the disease may be thereby masked, the patient seemingly improving under its use while symptoms of the gravest character are simply prevented from announcing, by their presence, the real condition. The patient may present a general appearance of well-being during which a sudden increase of pain, followed by distention of the abdomen, accompanied or followed by a rapid pulse and some rise of temperature, announce the occurrence of septic peritonitis. It should also be borne in mind that an exceptionally virulent infection may produce septic peritonitis with neither primary perforation of the appendix into the peritoneal cavity nor rupture of an abscess-cavity. Under these circumstances delay in operative interference will result in disaster, and even operation may fail to save the patient.

The indications for operative interference during an attack of appendicitis, save under the exceptional circumstances to be dwelt upon later on may be summed up as follows: As soon as a positive diagnosis of progressive appendicitis is assured, the abdomen should be opened and the appendix removed. If opium has been inju



ditionally administered and doubt thereby cast upon the progressive character of the case in hand, it is better to err upon the side of safety and remove the appendix. The conditions present are usually beyond the reach of remedial remedies or the power of nature to control. On the other hand, with moderately skilful surgical aid at hand and strict attention to aseptic details, both preliminary to and in the course of the operation, the latter entails less risk to life than that which is involved in even a mild attack of appendicitis which remains stationary at the end of twenty-four hours, with all the possibilities of lymphangitis, infection of the peritoneal cavity, retained muco-pus within the tube and rupture of the latter into an unprotected peritoneal cavity, or ulceration and perforation either from the presence of so-called coproliths or inspissated fecal matter imprisoned within the cavity of the appendix, or from gangrenous conditions alone.

While it is true that to operate too early may be to operate unnecessarily, it is equally true that this is preferable to operating too late and hence unsuccessfully. The fact that operative procedures are generally quite safely performed where a distinctly outlined tumor is present, providing the wall of the encapsulated abscess is not disturbed in the manipulation, has led some authorities to adopt this period of the disease as the stage of election. Under these circumstances, however, the surgeon will not be able to perform a complete operation, but must content himself with simply opening and emptying an abscess-cavity, the appendix itself being permitted to remain to give rise to subsequent attacks, one of which may prove fatal before the formation of an abscess. On the other hand, it is advocated to operate as soon as the diagnosis of appendicitis has been made, whatever its grade of severity. Between these extreme views held by those who favor operative measures a middle course is usually available. A case demanding operation within twenty-four hours from the beginning of the attack is exceptional. On the other hand, a case which is not well on the road to recovery at the end of the first day of the disease may be deemed progressive in character and should be made the subject of operative interference. This, however, must not be regarded as a hard and fast rule, and the surgeon should not limit himself to the period mentioned. Cases occasionally occur which present unusually severe symptoms within twenty-four hours, such as persistent high temperature and a succession of rigors, conjoined with exquisite tenderness in the right iliac fossa and the characteristic facial expression of a grave intra-peritoneal condition. Here the surgeon should not hesitate to give the patient the benefit of an early and radical operation.<sup>1</sup>

<sup>1</sup> The fact should not be lost sight of that the causes which lead to the develop-

as his thirst demands or his stomach will bear. This is to be supplemented by enemata of normal saline solution administered at regular intervals. The elevated head-and-trunk posture favors normal peristalsis, and serves both as a prophylactic and curative measure when peritonitis is to be feared (see page 206).

Vomiting may take place to an extent requiring the use of special remedies for its relief. If this occurs soon after the operation lavage should be practised with the view of getting rid of the mucus charged with ether which has passed into the stomach during the operation. Later on, the symptom is to be treated with  $\frac{1}{4}$ -grain doses of muriate of cocaine every one or two hours, counter-irritation to the epigastrium (thermo-cautery), or an occasional teaspoonful of plain hot strong coffee.

Abdominal distention is always a symptom which arouses anxiety. When this is accompanied with epigastric distress it may be relieved by lavage. Large quantities of gas will sometimes be thus expelled. The rectal tube should be passed frequently, and this supplemented by an enema containing milk of asafetida or turpentine. The addition of glycerin and sulphate of magnesium will sometimes bring away some faecal matter as well as gas and give marked relief. Where great abdominal distress accompanies the distention the practitioner should be on his guard against paresis or paralysis of peristalsis. Under these circumstances the use of opium should be carefully avoided, and reliance placed upon attempts to relieve the cause of the distress, *i. e.* the presence of gas in the intestines, by enemata. The favorite enema used in my hospital service consists of sulphate of magnesium, half an ounce; glycerin, one ounce; turpentine, one drachm; dried and powdered ox-gall, one drachm; hot water, a sufficient quantity to make six ounces.

If the intestinal canal is found to be responsive to its normal nerve influence, as evinced by the passage of gas *per rectum*, the bowels should be moved after the lapse of forty-eight hours following the operation. A tenth of a grain of calomel should be given every half-hour until ten doses have been taken, and this followed by a half-ounce dose of sulphate of magnesium. If this is not efficient at the end of four hours, drachm doses of sulphate of magnesium should be administered every half-hour, supplemented by enemata, until the desired result is obtained.

Where there is some anxiety concerning the state of the bowels, or reason to fear the occurrence of intestinal paresis or paralysis of peristalsis, attempts to move the bowels by means of the enemata alluded to should be made at the end of twenty-four hours. With the free expulsion of gas *per rectum* anxiety concerning the final outcome of the case is greatly lessened, and with a free movement of the bowels



the patient is generally safe from immediately threatening intra-abdominal complications. Attempts to nourish the patient may be made as soon as the effects of the anæsthetic have passed off.

The first nourishment given should be milk diluted with equal parts of water. This is to be given in teaspoonful doses every quarter of an hour until four or five doses have been taken. If no gastric symptoms appear, the water is omitted, the time lengthened to every half-hour, and the quantity doubled at each succeeding dose until full milk diet is reached (half a pint every two hours), or as near to this amount as the patient will take.

If the wound has been infected during the operation and suppuration takes place, this should be treated upon general surgical principles. Stitch-abscess should be opened up, freely curetted, and packed with antiseptic gauze.

The sutures should be removed at the end of a week, and the patient allowed to sit up in from ten to twelve days in uncomplicated cases. In suppurating cases the period of convalescence will be necessarily prolonged, and weakened abdominal walls and the fear of ventral hernia compel the patient to remain in the recumbent position for three weeks longer.

Gauze-packing or wick-drainage must be left undisturbed for at least four days, or until the infected area has been well walled off beyond the drains. Wicking may be removed strand by strand, thus permitting the cavity which it occupies to gradually collapse.

The surgeon will sometimes be compelled to content himself with simply evacuating a pus-cavity or an encysted intra-peritoneal sero-purulent collection. While this will be rarely necessary in the practice of those familiar with abdominal work, yet even with such the best interest of the patient will frequently be served by avoiding breaking down adhesive barriers. As soon as the immediately threatening local septic conditions have subsided, the appendix may be sought for and removed, the edges of the wound freshened, and an attempt made to obtain primary union of the latter. This is to be preferred to waiting until the wound has entirely healed by granulation, and reopening the abdomen.

Grave complications following the operation when performed early in the attack, or in the intervals between the attacks, are comparatively rare. On the other hand, these are always to be apprehended when operative interference is instituted late in the disease, and will always tax the resources of both the medical and surgical therapist to the utmost. Either pre-operative peritonitis which the removal of the source of the infection fails to influence favorably, or post-operative peritonitis resulting from failure, unavoidable or otherwise, to prevent spread of infection from the immediate neighborhood of the

appendix in advanced cases of the disease, constitutes the source of greatest anxiety: our resources for combating this complication are unfortunately limited, and only too frequently inefficient.

Upon the appearance of the first symptoms of this complication prompt measures should be taken to procure free catharsis, for the purpose of securing drainage of the peritoneal cavity. The use of saline following the exhibition of  $\frac{1}{6}$ -grain doses of calomel repeated every quarter of an hour until a grain has been taken, seems to best fulfil the indications. These may be supplemented by frequent enemata containing glycerin, turpentine, and ox-gall. Counter-irritation of the surface of the abdomen has enjoyed considerable repute in times past and this has been most frequently effected by the use of turpentine stupes. All the benefits of this treatment can be obtained in a more efficient and cleanly manner by the use of the button-shaped attachment of the thermo-cautery heated to a white heat and barely brought in contact with the surface in a great number of places.

The beneficial influences of surface applications of guaiacol for the relief of deep-seated inflammations suggests its use in peritonitis. Care should be exercised in its use in the case of old persons and young children, on account of the atrophied skin of the former and the delicate skin of the latter. It should be diluted with either alcohol or oil of sweet almonds in the proportion of 1 to 15 or 20, and pencilled over small areas at a time and covered with a cotton poultice (cotton batting covered with oil-silk).

The ice-coil has gone somewhat out of fashion. The fact that it has been deemed scarcely possible to reach and modify the inflammatory condition through the thick abdominal walls, together with symptoms of bladder-inflammation which it has been accused of producing, have contributed largely to this. I continue to employ it, however, for the reason that it assists in lowering the general temperature and gives a sense of relief and comfort to the patient; further, I have but rarely seen bladder-irritation result from its employment.

Intestinal obstruction from the formation of the vicious adhesions is a complication to be dreaded both as an immediate and a remote complication in cases operated upon late in the disease. The necessity for the introduction of drains of any kind renders this complication more likely to occur, as well as the existence of inflammatory processes which have extended from the appendix to the region about the ileocecal valve. It is highly important to differentiate in the first few days between this mechanical obstruction and that due to septic peritonitis and intestinal paralysis, for the reason that in the former immediate reopening of the abdomen and relief of the angulated and constricted intestines is indicated, while in the latter no benefit is to



be derived from operative interference. In the case of mechanical obstruction the sounds produced by the movements of volumes of gas from one part of the intestinal canal above the obstruction to another can be made out with the stethoscope, while in that due to intestinal paralysis these sounds are absent. Obstruction occurring later on will be easier of differentiation. This condition may occur at any time following the operation, and is sometimes present as a complication before operation. (See article on Intestinal Obstruction.)

Ventral hernia is also a sequel which occurs more frequently in cases the subject of late operation. The presence of suppuration prevents that solid closure of the abdominal wall which is obtained when union takes place by primary intention. The muscular and fascial edges are separated by the presence of cicatricial tissue, and this eventually undergoes degenerative changes which lead, in some cases, to its almost total disappearance—that portion which unites the skin alone, in old cases, constituting the sole covering of the abdominal contents; this in time becomes attenuated, and the movements of the intestinal coils can be seen through the thin structure. While the use of support to the abdominal surface generally may give a sense of relief to the patient, this cannot be of permanent benefit, and the wearing of a pad over the cicatricial tissue may do positive harm by its pressure, thus hastening the atrophic changes which finally occur in many cases. In pronounced or extreme instances of this troublesome sequel the plan of election is to dissect out all the cicatricial tissue still remaining and bring the muscular and fascial margins together anew.

Weakening of the abdominal wall at the site of the operation is a not uncommon result of late operations in which it becomes necessary to make an extensive dissection, prolonging the incision to the extent of injuring the nerve-supply of the parts in the immediate vicinity of the field of operation. Here, although the successive layers may be firmly united as to their edges, yet there will be a general bulging upon the side operated upon, as compared with the other. The condition is irremediable so far as at present known. An abdominal support may be of service, if there is a sense of dragging. Patients, however, rarely complain of this discomfort.

From what has been said of the dangers and inconveniences accompanying or following late operation as compared with early surgical interference much difference of opinion has existed, but the following may be accepted as the views upon this question held by those whose experience in the disease under consideration entitles their opinion to respect:

(1) Early operation means the avoidance of almost all risk in the operation itself, even in the hands of those of average or even slight experience in operative work, provided the underlying principles of

aseptic operative technique are understood and acted upon. This also secures early convalescence, the avoidance of dangerous complications and sequels, and, in addition, immunity from subsequent attacks of the disease.

(2) Late operation exposes the patient to grave dangers before, during, and following the operative procedure, and demands that the latter be undertaken only by one thoroughly familiar with all of the most difficult details of the technique of abdominal surgical work. The convalescence is prolonged, and the patient not infrequently emerges from the conflict almost a complete wreck, and may require months for final restoration to health. The mortality is correspondingly high, and the operation is frequently held responsible for the fatal issue, when, as a matter of fact, the conditions found to be present are incompatible with recovery in any event. The occurrence of vicious adhesions may lead to intestinal obstruction at any time during the life-time of the patient. The presence of ventral hernia may require a subsequent operation for its relief. In not a few instances the surgeon is compelled to leave the appendix behind, thus rendering the patient liable to subsequent attacks, the only other choice being that of submitting to a secondary operation.

While it may be said with truth that some cases operated upon might have recovered without operation, this consideration is more than balanced by the fact that no one can ensure this to the patient in any given case, much less promise him immunity against subsequent attacks, as well as the fact that the mortality of cases operated upon early, or when the infection is limited to the organ itself, is not higher than one-half of 1 per cent. in competent hands. When the patient recovers without operation the result is attributable to the fact that the disease was not beyond the power of nature to control, and not to the influence of remedial agents, for the reason that there is no drug known whose direct action is such as to effect any favorable change whatever in the inflammatory process in which the organ is involved. Finally, in cases in which recovery ensues under purely medical treatment, the patient must always dread a recurrence of the malady. The delay which medical practitioners frequently counsel in cases of appendicitis is largely responsible for the many valuable lives that have been lost from the disease since its dangerous character has become known, as well as from operative attempts instituted at a late stage of the disease, which have proved ineffectual.

**THE NON-OPERATIVE TREATMENT OF APPENDICITIS.**—The non-operative or so-called medical treatment of this disease will be called for under the following circumstances:

(1) When the conditions under which the patient is placed are such as to prohibit the employment of skilled surgical aid at a time



in the course of the disease when the greatest skill possible is necessary in carrying the operative procedure to a successful issue, namely, when the infection has passed beyond the limits of the appendix itself and has involved the surrounding parts, although it is at this very time, save in but a few exceptional instances, that operative interference is really most imperatively demanded.

So long as the infection is confined to the organ the operative procedure to be instituted is the simplest of all those for which abdominal section is demanded. The route is direct, the large intestine easily identifiable, the caput coli readily found, and the vermiform appendix of the cæcum brought into the abdominal wound with ease and ligated and excised. With strict limitation of the infectious process to the organ itself, with no ulceration or perforation of the appendix, and in the absence of infected serum in the abdominal cavity and supuration in the adhesions, if such have been formed, it is still possible for the case to go on to recovery with no complicating sequelæ, although an exceptionally large and varied experience in the treatment of appendicitis impels me to insist at every opportunity that there is no means of knowing, in a given case, whether or not such a favorable course will be followed. In the majority of cases, how-

On the other hand, there comes a time in a large number of cases when it becomes an extremely difficult task for the most skilled surgeon, versed in all the special technique of abdominal section necessary to prevent infection of the peritoneal cavity both from the infectious processes present in the appendix and its neighborhood, as well as from without, to deal with the conditions present in a manner at all calculated to bring the case to a successful issue.

Therefore, under the circumstances of a mild attack, and in the absence of threatening symptoms, as well as with a severe attack at hand and the actual presence of the latter, if the patient be located at a point remote from surgical aid he will be likely to be treated non-operatively. For this reason it behooves us to carefully consider what course the attending physician should pursue in order to give his patient the best possible chance, next to that of operative interference, for recovery.

(2) There is a class of cases in which it may be deemed best to defer operative interference until a later period of the disease, holding the latter in reserve. These are cases in which the patient's general state will not admit of interference, and in which the general disturbance is out of all proportion to the local conditions. High fever, a rapid pulse, and great prostration may be present, and yet the local disease be comparatively insignificant. This is particularly apt to be the case during pregnancy, and the careful and experienced clinician will be on his guard, knowing the unfavorable prognosis to

be apprehended with this condition complicating an attack of appendicitis, whether the latter be treated operatively or expectantly.

(3) Cases occasionally come under the care of the surgeon in which the conditions present are such as to lead him to believe that the risk involved in operating can scarcely be exceeded by those taken declining to open the abdomen and treating the patient expectantly; however hopeless the outlook may appear. Under these circumstances the patient is staggering along under a burden which he is just able to carry and live; any attempt at interference must necessarily increase the burden temporarily, and he dies before the beneficial effects of getting rid of a portion of his original burden can be realized.

Assuming the views here expressed to be correct—and in the present state of our experience they can scarcely be denied at least—earnest consideration on the part of all—there is scarcely room for doubt in the minds of those who have been brought much in contact with appendicitis, that surgical measures, and these alone, are competent to deal effectively with the disease when the latter is progressive in character. In mild cases of catarrhal or endo-appendicitis with but slight interference with the blood-supply and in the absence of virulent infection, the inflammatory action may not extend beyond simple thickening of the mucosa, or at the most involve but slightly destructive changes, and hence these cases should quickly clear up under saline purgation and rest in the recumbent position. But even here there is a source of danger not heretofore sufficiently dwelt upon and which is illustrated in a case coming under my care, in which with a history of several preceding indubitable attacks of appendicitis, I was impelled to open the abdomen promptly during an exceptionally mild attack. The conditions present were such as to fully justify the procedure. The appendix was greatly distended with muco-purulent secretion almost to the point of rupture (emphysema of the appendix), and with practically no adhesions present. Upon examination after removal it was found that communication with the cæcum had been entirely shut off by a stricture—the result of a former attack—at the appendiculo-cæcal orifice, constituting a most dangerous condition of affairs.<sup>1</sup>

The first point upon which the practitioner should bestow his attention upon being called to a case of appendicitis is the state of the bowels. If these are constipated an enema should be given and this followed by a dose of sulphate of magnesium or other saline cathartic, since these drugs possess the property of not only emptying the intestinal canal, but likewise of effecting drainage from the neighboring peritoneal structures by endosmotic action. To be a safe pro

<sup>1</sup> *Medical Record*, Nov. 7, 1896.



cedure, however, this must be instituted at the very commencement of the palpable symptoms. Van Cott has shown that neural and vascular changes may precede the onset of the acute symptoms, and my own experience teaches me that these may lead to rapidly gangrenous condition.<sup>1</sup> With these at hand violent catharsis may invite early perforative peritonitis. Therefore, if prompt emptying of the intestinal tract cannot be accomplished, it is better to forego entirely this portion of the treatment until opportunity has been afforded for the formation of protective adhesions, which may take several days. In any event an enema to clear out the lower bowel should always precede the administration of the cathartic. If the case is a progressive one and suppuration in the appendix or surrounding adhesions takes place, catharsis should also be carefully employed, if at all, for the reason that if these adhesions are rendered tense by the accumulation within their boundaries they may be easily broken down by forced peristalsis, and secondary rupture into the peritoneal cavity take place, with resulting general septic peritonitis. After the first few days the bowels may be moved by enemata daily, all straining efforts being avoided.

The patient should not be permitted to rise from the bed either to urinate or defecate. This rule is imperative, and no argument or insistence on the part of the patient should induce the practitioner to accept the responsibility of movements on the part of the patient that may easily lead to his destruction through the supervention of general peritonitis following either primary perforation or secondary rupture. The same rule should apply to voluntary muscular efforts in bed, such as rising and turning over. None but absolutely necessary movements are to be permitted, and these should be entirely of a passive character, *i. e.* with the assistance of another. The medical attendant should ever keep before him the vision of an appendix violently inflamed, gangrenous in whole or in part, and lying loose in the cavity of the peritoneum waiting for some more or less violent effort on the part of the patient or forced peristaltic movement of the surrounding intestinal coils to empty its death-dealing contents into the peritoneal cavity. Even when all seems to be going on favorably the same caution should still be exercised, for the reason that, even if the inflammatory condition of the organ is subsiding, an encysted sero-purulent collection in the surrounding area, resulting from a perforation that has healed, or an infection through the circulatory channels without perforation, will do almost, if not quite, as much damage as a primary perforation, if its barriers are broken down and its contents permitted to invade the peritoneal cavity. Rest, therefore, abso-

<sup>1</sup> *A Treatise on Appendicitis*, by George R. Fowler, M. D., 2d edition, Philadelphia, 1900.

lute and prolonged, should be insisted upon in a most positive and unequivocal manner by the medical attendant.

It is easier to state the contraindications to the employment of opium than to lay down rules for its use in appendicitis. It is a two-edged sword that cuts both ways, and, unfortunately, its keenest edge is turned in the direction of the patient's comfort. There is an almost irresistible impulse on the part of the practitioner to administer a sufficient amount of the drug to allay the pain completely. If the question of operation has been discussed and definitely disposed of in the negative, and the medical attendant is fully aware of the fallacies in the prognosis which this drug gives rise to—in other words, if he is not misled by the apparent improvement in the symptoms which follows its administration, and is on his guard against indiscretions on the part of the patient into which the latter is led by what to him appears to be an abatement of all the uncomfortable features of the disease—then, and only then, is its employment justifiable, to a limited extent, if other measures fail and the patient is being harassed and worn out by pain and restlessness. If the operative procedure is still under consideration, and the question of its application to the case in hand not yet settled, but, on the contrary, is made to depend upon the possibilities of improvement or otherwise within the next few hours, then, in order to form a fair estimate of the progressive or non-progressive character of the attack, and in the patient's own best interests, it is better not to mask the natural symptoms. With its complete withdrawal and steady improvement following there can be but slight opportunity for error, particularly if the symptom of localized tenderness be carefully watched and estimated at its full value. Under these circumstances the question of operative interference can be intelligently discussed, if indeed it can be said to be open for discussion at all after the first twenty-four hours of the existence of the disease with no natural and material amelioration in the symptoms. On the other hand, if opium or its preparations are permitted to mask the course of the disease the practitioner must remain more or less in the dark as to its actual possibilities, and thus be the more readily deceived as to the indications for surgical interference, and in cases in which operation is refused, or deemed impracticable either because of the environment or other equally good reason, as to the actual state of affairs within the patient's abdomen and the necessity for constant vigilance against the occurrence of a catastrophe.

In cases in which it is finally decided to trust to nature's efforts to resist the further invasion of the disease (for, after all, this is what treatment by drugs amounts to so far as "cure" of the appendical inflammation is concerned), then it will become necessary to



relieve the patient's sufferings primarily, and secondarily to secure that rest of the inflamed parts surrounding the original focal lesion so absolutely essential to the formation and maintenance of proper adhesions for the protection of the peritoneal cavity pending the subsidence of the appendicitis itself. The treatment, under these circumstances, becomes the treatment of a localized infectious peritonitis in which it is believed with reasonable probability that the lesion is of a suppurative character and must be kept strictly within its then present limits; the judicious employment of opium, *i. e.* the smallest possible dose that will keep the patient in some approach to comfort, is to be chosen and steadily adhered to save under circumstances of emergency, and is to be continued until the necessity for its employment has passed away. In its withdrawal some substitute may be given, of which bromide combinations serve the best purpose. Under the watchful care of an alert practitioner opium may, with proper precautions, become an unmixed blessing in the treatment of appendicitis in the class of cases in which its employment is admissible; in the hands of one less vigilant and unmindful of its treachery it becomes a Lorelei beckoning on the innocent victim to his destruction.

With the occurrence of an inflammatory mass in the right iliac region (and this should be sought for occasionally, the gentlest manipulation only being admissible, examination by percussion being largely substituted for palpation) the watchfulness of the medical attendant must be redoubled. The more acutely painful symptoms now subside, and, since the adhesions have become well formed, there is a double indication for the lessening of the dose, or the withdrawal of the drug altogether save for the purpose of allaying impatience and restlessness on the part of the patient, or for securing sleep at night. These may perhaps be as well secured by small doses combined with one of the bromides, or the latter may be found sufficient alone.

Local applications are of but little use in arresting the disease, yet the application of a small ice-water coil, or a rubber bag filled with ice, is a favorite application with many medical men, and occasionally patients declare that it affords relief from pain. For this reason alone it should be employed, since it thus enables the attendant to cut down still further the amount of opium employed.

During all this time the nutrition of the patient must be kept up and his general system fortified against the septic material which is being slowly fed into his circulation and distributed to his tissues, or eliminated by the natural outlets. The skin and kidneys are important agents in the last-named particular, and should receive attention. The food should be such as will leave the least possible amount of residuum and still be sufficient for the needs of the system, having in mind the undesirability of administering cathartics for the forced

emptying of the intestinal canal. Milk, white of egg in water, and farinaceous gruels and meat broths are indicated, sufficient variety being furnished to make these acceptable to the patient. Digestive disturbances should be met by a change in the diet, if one or two of the allowed articles only have been used, and the administration of remedies such as hydrochloric acid and the digestive ferments.

Febrile disturbance is not usually a grave feature of the disease, and hence antipyretics are but seldom demanded. Their use, like opium injudiciously administered, only tends to mask the real conditions. If sepsis is present the synthetically prepared antipyretics, such as phenacetin, antipyrin, and antifebrin or acetanilid, only have the permanent effect of weakening the cardiac muscle, and hence will be harmful if given. Tonic doses of quinine are admissible, and, according to the dose given and the susceptibility of the patient thereto, the antipyretic action obtained properly discounted in estimating the patient's condition as based upon the temperature indications.

The use of strychnine has a proper place in the therapy of appendicitis, and this drug may largely replace the employment of alcoholic stimulants. With failing strength its employment, in  $\frac{1}{30}$ -grain doses, in connection with quinine, digitalis, or sparteine is useful. Nitroglycerin with caffeine aids the action of the kidneys in their eliminative function by raising the blood-pressure and lessening the resistance in the capillary circulation, and hence these drugs are useful both in this respect as well as in their influence upon the flagging heart.

The occurrence of rupture of an intra-peritoneal encapsulated abscess is marked by the sudden subsidence of the inflammatory mass and symptoms pointing to the route chosen by nature in getting rid of the offending pus. If this be into the peritoneal cavity the characteristic symptoms of acute general peritonitis soon manifest themselves. There is an accelerated pulse-rate, great abdominal pain, accompanied by an anxious countenance and followed by tympanitic distention and vasomotor paralysis. If by the intestinal canal, there soon appears a diarrhoea, or at least several loose discharges, according to the amount of pus which the abscess-cavity contained, with the indubitable evidences of the presence of pus in the stools. If by the bladder, pus, and in some instances faecal matter, if both routes have been chosen, will be present in the urine. Under these circumstances symptoms of cystitis make their appearance and require treatment. In the female the discharges may take place from the vagina. The collection may make its way through the diaphragm and perforate the base of the lung after the formation of pleural adhesions, and escape into a bronchus. In at least one instance with which I am familiar

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the occurrence of this latter accident was followed by the patient's sudden death. He was literally drowned by the rapid flow of the pus. The pleural cavity may receive the collection forced upward by the pressure from below, and an "empyema necessitatis" follow, if the patient survive. The pus may escape in a post-peritoneal direction and invade the deep structures of the back, or follow the iliac vessels over the pelvic brim into the thigh and simulate a psoas abscess in its final pointing. Least likely of all, it may discharge into the abdominal wall and terminate as a parietal phlegmon, pointing by preference in the neighborhood of the umbilicus.

The treatment to be pursued under these varying circumstances of spontaneous evacuation will vary with the route chosen by the advancing pus. If the direction taken be into the peritoneal cavity, unless the abdomen be promptly opened, the patient's doom is sealed, and, beyond the benefits to be derived from euthanasia, the medical attendant's functions cease: opium in sufficiently large doses to tide the victim over the last agonies is alone indicated, from the purely medical standpoint. Even surgery offers but little hope, for the patient's condition at this stage of the case is generally such as to prohibit the use of an anæsthetic, much less will it permit the additional shock incident to opening the abdomen in the face of profound collapse and general sepsis, which rapidly supervene.

If the pus is evacuated through the bowels, beyond an occasional low enema nothing need be done. If the communication between the fæcal current and the abscess-cavity is into the small intestine reinfection of the latter usually takes place, and this may be repeated again and again until either the patient's strength is exhausted or the surgeon is called in to right the matter by providing a route for the escape of the pus by means of abdominal section and drainage. The fæcal fistula which follows frequently closes spontaneously; if persistent it may be closed by a subsequent plastic operation. If the abscess-cavity has emptied into the colon or rectum, the outlook is more favorable, for by the use of enemata the lower bowel can be kept empty and the fæcal current diverted from the opening in a certain proportion of cases. Cathartics are not to be given under these circumstances, the object being to avoid as far as possible the presence of liquid fæcal matter in the invaded bowel; otherwise the conditions present in the small intestine will be produced and healing of the communication delayed, or prevented altogether. Even with all the care in this respect possible, reinfection is apt to occur and an operation become finally necessary.

If the bladder has been invaded the resulting cystitis must be met by washing out the bladder occasionally by means of boric-acid solutions. The bladder should not be entirely filled with the solution.

Infection of one or both kidneys may result from failure to keep the cystitis within bounds or the bladder disinfected. If the intestine and bladder are both invaded these efforts must be redoubled. Surgical interference (suprapubic cystotomy) alone will suffice when this latter complication arises.

The vaginal route is perhaps the most favorable of all those mentioned. The opening is usually in the vault and affords direct drainage, and borico-salicylic acid (Thiersch's) solution, used as a vaginal douche, fulfils all the indications.

The diaphragmatic route, next to that leading into the peritoneal cavity, is the least favorable. In addition to the immediate dangers from flooding the respiratory tract, those arising from septic pneumonia are to be apprehended. The prognosis of empyema resulting from the presence of the discharged pus, as well as the suppurative process set up in the pleura itself from infection, is most grave and is to be met by operative procedures designed to evacuate the collection and provide free drainage at once.

The escape of pus into the post-peritoneal connective tissue and its invasion of the deep structures of the back is soon followed by grave constitutional disturbances of septic origin. If the pus makes its way along the route followed by the vessels and appears in the thigh, the collection may be evacuated by an incision and drainage established. The same course is to be followed in case the route followed by the pus leads into the abdominal wall.

Other complications to be feared are hepatitis of septic origin; septic emboli form in the mesenteric veins and are swept into the portal circulation. This is announced by pain and tenderness in the region of the liver, jaundice more or less pronounced, and increased constitutional disturbance. The outlook under these circumstances is grave, although the case is not necessarily a hopeless one. No specific medication will be of use. Suppurative hepatitis is to be feared, and occurs in a certain proportion of cases.

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#### PARATYPHLITIC ABSCESS.

WHILE the great majority of cases of supposed typhlitis and perityphlitis, as well as typhlitic tumor and paratyphlitic abscess, have their origin in inflammation of the vermiform appendix, yet cases of suppurative inflammation in the right iliac fossa, originating in the neighborhood of the cæcum or caput coli, do certainly occur in which the operative procedure discloses a normal appendix, or even after the latter has been removed for appendicitis. This is true, in spite of the



more generally received opinion that abscesses in this region are exclusively of appendicular origin—an opinion so widespread that recent writers, as a rule, entirely ignore the possibilities of their occurrence from other origin. Between this and the opposite extreme, held by Dupuytren and afterward put forth by Albers, there is probably ground for dissent from both opinions.

Paratyphlitic abscess is a suppurative inflammation in the connective tissue about the cæcum. This may occur in the normal structures or in the adhesions which have previously formed from inflammatory conditions of the cæcal wall (typhlitis) and its serous covering (perityphlitis). The typhlitis itself may have its origin in fæcal accumulation (stercoral typhlitis of Lenander), this tending to a catarrhal inflammation, limited to the mucous membrane, or to a parietal typhlitis whose seat is in the interstitial or intermuscular structure of the wall of the cæcum, with engorgement of the vessels and the presence of an exudate in the perivascular spaces. Or, it may occur from nutritive disturbances of the bowel-wall, following (1) vascular changes with resulting ulceration or the occurrence of gangrenous areas with perforation; or (2) neural lesions with consequent trophic changes in the bowel wall. Finally, it may result from the action of some foreign body or the presence of dysenteric, typhoid, or cancerous ulcers. The mechanism of the infection consists, in those cases in which no perforation exists, in bacterial migration, the causative lesion robbing the intestinal wall of its natural property of intercepting the passage of micro-organisms through its tissues, and, in the cases in which perforation occurs, in direct infection from contact with the fæcal contents of the bowel.

#### SYMPTOMS AND COURSE OF PARATYPHLITIC ABSCESS.

The symptoms of paratyphlitic abscess are the presence of a tumor in the right iliac fossa, the appearance of which has been preceded by the more or less sudden occurrence of pain and tenderness in this region. These, in their turn, may have been preceded by loss of appetite, disturbances of digestion, and constipation, and followed by slight fever, and occasionally vomiting. If the case is seen in the stercoral typhlitis stage a doughy mass may be very readily felt in the neighborhood of the right iliac fossa. Considerable distention may take place in the course of the case from accumulation of fæcal matter and gas. In exceptionally severe cases intestinal obstruction may occur. Localized peritonitis is always present. The suppurative collection may perforate posteriorly and invade the retro-peritoneal connective tissue and simulate a perinephritic abscess, or follow the space between the lateral abdominal wall and the colon and perforate the diaphragm. It may invade the sheath of the psoas muscle and

find its way to the thigh. Flexion of the right thigh will be present in these cases.

**DIAGNOSIS.**—Paratyphlitic abscess is of exceptional and even very rare occurrence as compared with the frequency of appendicitis, from which disease it is to be carefully differentiated. It is of less abrupt onset than the latter, and the pain is less severe and more distinctly localized from the commencement. The general symptoms are less pronounced, as a rule, although an appendicular lesion may go on to perforation and lead to general septic peritonitis without serious preceding constitutional disturbances. The tumor in paratyphlitic abscess, in cases of stercoral origin, is present from the commencement of the symptoms, while in appendicitis there is usually seen in acute cases supervening upon a chronic condition following a former attack, a distinct period of from two to four days, between the onset of the attack and the appearance of a tumor. In typhlitic tumor the mass is sausage-shaped, situated at the site of the cæcum, can be indented by the finger, and is less tender than the tumor of appendicular origin, which may be lower down below the level of the anterior superior spinous process of the ilium, is irregularly shaped, and, unless the symptoms are masked by opium, exquisitely tender. When suppuration has taken place in the paracæcal structures attempts to establish the differential diagnosis will be futile save through an operative procedure. In the simple catarrhal and even sometimes in the parietal form of typhlitis the symptoms are promptly relieved if the bowels are well acted upon by a laxative. Cases of paratyphlitic abscess resulting from perforation following ulcerative action, gangrene of the bowel-wall, and foreign bodies, are usually impossible of differentiation from appendicular lesions. In case of doubt it is better to lean to the side of appendicitis.

**PROGNOSIS.**—The prognosis is favorable if the suppurative process is not permitted to find its way into regions inaccessible for purposes of complete drainage after incision.

**TREATMENT.**—Complete rest in bed, the administration of a saline cathartic, and the local use of an ice-bag will be appropriate measures of treatment if instituted in the stage of fecal accumulation, and before the occurrence of localized peritonitis. If the latter supervene opium may be given in cautious doses. As soon as suppuration occurs the collection is to be evacuated. This may frequently be done without invading the peritoneal cavity by making the incision as for ligation of the epigastric artery, and crowding back the peritoneal fold, so as to gain access to the abscess-cavity.

In cases with sudden onset, in which perforation has probably already occurred, the operation should be promptly done as for appendicular lesions. In all cases in which the fullest and most posi-



tive evidence of a preceding stercoral typhlitis cannot be obtained the patient should be given the benefit of the doubt and the case treated surgically as for appendicitis.

### INTESTINAL OBSTRUCTION.

FOR purposes of general classification intestinal obstruction may be divided into the following:

1. Constriction of the bowel from without (strangulation).
2. Obstruction from displacement and simple flexure (angulation).
3. Obstruction from twist and complex flexure (rotation).
4. Obstruction from blunt pressure from without (compression).
5. Obstruction from closure of the intestine from within (coarctation).
6. Obstruction from plugging of the intestine from within (obturation).
7. Tract of bowel paralyzed (dynamic).

Two, or even more, of these forms of obstruction may be combined in the same case.

The following clinical forms are distinguished:

1. Internal strangulation.
2. Intussusception.
3. Volvulus.
4. Congenital occlusions and acquired strictures.
5. Fæcal obstruction.
6. Foreign bodies.

1. **Intestinal Strangulation.**—In this form of obstruction the constriction or occlusion of the bowel takes place from its peritoneal surface. It includes (*a*) obstruction by pressure of adventitious tissue or bands from pre-existing peritonitis, fetal or otherwise, adhesions of inflammatory origin causing abnormal displacements and fixation of the intestinal tube and consequent "kinking" or angulation; (*b*) obstruction from the presence of the remnants of the omphalo-mesenteric duct known as Meckel's diverticulum; (*c*) the presence of openings in adjoining folds of peritoneum, such as mesenteric and omental slits, into which a knuckle of intestine is forced and becomes imprisoned; (*d*) appendicular inflammatory lesions in which the inflamed appendix becomes adherent in such a position as to partially surround a portion of adjoining intestine in a constricting loop, or acts as a band and produces obstruction by pressure; and finally, (*e*) true internal hernia, a portion of intestine entering the duodeno-jejunal

bowel obstruction is caused by the mucous suspension of the large intestine.

**2. Obstruction arising from Intussusception.**—In this form the invagination or telescoping of one part of the intestine into another, due to irregular and forced peristalsis. The invagination always occurs from the forward and includes the following varieties: *(a)* ileocolic, when the invagination is limited to the colon; *ileocaecal*, in which the ileum is prolapsed into the ileocaecal aperture; *enterocolic*, when the small intestine alone is involved; *colocolocolic*, the colon descending into the rectum; *(c)* *rectal*, the rectum invaginating into itself.

**3. Volvulus.**—In this form a twist of the bowel upon its mesenteric axis occurs. Its location is usually at the sigmoid flexure. The twist becomes more pronounced as distention of the bowel above the lesion progresses. Nutritive changes in the intestinal wall occur early and bacterial migration and septic peritonitis follow, as a result of which the parts involved become firmly fixed in their abnormal position.

**4. Congenital Occlusions and Acquired Strictures.**—The include *(a)* absence of a portion of the intestinal tube from arrest or imperfect development, such as imperforate anus, absence of defective union between the sigmoid flexure and the rectum, the pylorus and duodenum, etc.; *(b)* strictures from morbid growth either malignant or benign, of which the former are by far the most frequent; *(c)* cicatricial contraction from healed typhoid and other ulcers; *(d)* occlusion arising from the pressure of pelvic and abdominal tumors, and from the presence of inflammatory exudates about the bowel.

**5. Fæcal Obstruction.**—Accumulation of fecal matter in an isolated portion of the intestinal canal arises from a local arrest of peristalsis, and results, if sufficiently prolonged, in paralysis of the involved portion of bowel, and finally, with increased size of the mass and its desiccation and hardening from absorption of its fluid constituents, obstruction from plugging of the bowel and stenosis of the adjacent intestinal canal. Its most frequent seat is the large intestine in the neighborhood of the caput coli and cæcum. Septic inflammatory conditions may arise when the wall of the gut is greatly distended or under circumstances of pressure from exceedingly hard masses within the bowel and resulting interference with the nutrition of the bowel-wall and bacterial migration. It follows most frequently a constipated habit, and is observed oftenest in females and in the aged. It may be due remotely to congenital conditions, and is favored by sedentary habits. Other predisposing causes are hysterical and hypochondriacal conditions and spinal cord affections.

6. **Foreign Bodies.**—Obstruction by foreign bodies includes that which arises from gall-stones, enteroliths, and masses of lumbricoid worms, as well as substances swallowed, such as coins, buttons, etc., and certain medicinal substances (magnesia and bismuth). Gall-stones are most frequently arrested in the ileo-cæcal region and enteroliths elsewhere in the small intestine.

#### SYMPTOMS AND COURSE OF INTESTINAL OBSTRUCTION.

Intestinal obstruction may be acute or chronic in its onset and course, according to the cause of the obstruction. Further, there may be present symptoms of a chronic or slowly progressive character for a time, these being followed by symptoms pointing to the super-vention of acute obstruction.

Acute obstruction is characterized by abdominal pain, nausea and vomiting, tympanites, and inability to pass gas by the rectum after the point below the obstruction has been emptied; occasionally tenesmus, when the obstruction is low down, and sometimes the presence of a dull tumor. Distended coils of intestine sometimes elevate isolated portions of the abdominal wall, forming a tympanitic tumor. Moderate rise of temperature may be present.

In chronic obstruction due to impacted fæces diarrhœa may be present at first. The mucous membrane in the neighborhood of the impaction becomes the site of a catarrhal inflammation and the secretion furnished passes alongside of and through the mass, carrying with it some fæcal matter. This, however, soon ceases and symptoms of complete obstruction slowly occur. There is a sense of fulness and weight in the abdomen, with general uneasiness, loss of appetite, foul taste and furred tongue, and pain, induced by pressure, referred to the distribution of the sacro-lumbar nerves. Swelling of the abdomen occurs, and, sooner or later, a tumor is made out. A general lethargy is followed by prostration, or symptoms of obstruction of an acute character may supervene. When the obstruction is due to malignant disease of the bowel-wall, there will have existed constipation previously, and, in isolated instances, some pain and localized tenderness which is increased by the administration of cathartics. There is increasing difficulty in effecting movements of the bowels, with loss of weight and strength, and anæmic dyscrasia.

Hiccough may be present in either form. Fæcal vomiting, and expulsion of brownish-colored serous contents of the small intestine without apparent effort, occur finally in nearly all cases of complete obstruction of the small intestine. Fæcal vomiting is not nearly so constant a symptom in obstructive conditions of the large intestine, although in volvulus at the sigmoid flexure it may be an early and prominent symptom. The evidences of tumultuous peristalsis in the

shape of gurgling sounds are sometimes apparent both to the patient and the attendant, and when not so apparent may be obtained by auscultation. The stools are stained with blood in malignant disease of the lower bowel, and tenesmus, followed by bloody mucus in the stools, is especially characteristic of intussusception, although not always present. Localized peritonitis results from bacterial migration and infection from the interior of the intestine following disturbances of the normal physical characters of the intestinal wall from whatever cause. This occurs with especial rapidity in volvulus, the twist of the mesentery interfering early with the nutrition of the bowel. Fatal cases of intestinal obstruction are marked by typical and early collapse, the effects of the stercoræmia being particularly manifested upon the nervous system. There is vasomotor paralysis, a bluish-red color of the surface, lowered temperature, and feeble pulse.

In cases primarily acute the practitioner may suspect either internal strangulation, internal hernia, intussusception, or volvulus. In all cases the usual sites of hernia, viz. the inguinal, umbilical, and crural outlets, as well as the unusual localities in which this occurs, such as the perineum, the obturator foramen, and lumbar region, should be interrogated. In chronic obstruction cicatricial narrowings, stricture from malignant and benign neoplasms of the bowel-wall, occlusions from tumors or inflammatory processes, and foreign bodies or faecal impactions, are each to receive due consideration in the differentiation.

It is not usually difficult to reach a conclusion that obstruction actually exists, although acute enteritis, acute poisoning, and strangulated hernia have all been mistaken for intestinal obstruction. The most frequent diagnostic errors, however, relate to appendicitis and peritonitis (see pages 436 and 446).

The anatomical diagnosis, save in indubitable cases of faecal impaction, is always difficult and frequently impossible without the aid of exploratory abdominal section. The seat of pain in all varieties and situations of intestinal obstruction is apt to be at or near the umbilicus, and when not so located is generally diffused. Tenderness is not always present, and in any event its situation is barely suggestive, much less diagnostic. From the greater frequency of faecal vomiting in cases of obstruction in the small intestine, this symptom may be of some service in the differentiation. A tumor felt by the finger in the rectum or vagina is suggestive of intussusception when acute symptoms are present. Digital exploration of the rectum may reveal a stricture or other evidence of disease, if this is within reach. On the other hand the lesion may be located in the large intestine high up, or in the small intestine, in which case it will not be acces-



sible to digital exploration. Exploration with the hand in the rectum is a procedure the results of which, as a diagnostic measure, have not justified the risks taken in its employment. The Sims position used in gynecological work is convenient for digital, and the knee-elbow position for instrumental, examination. In faecal obstruction the uneven mass may be sometimes felt in the course of the bowel.

Obstruction high up in the small intestine is accompanied by scantiness of urine and moderate distention at the upper portion of the abdomen. There is flatness below and in the sides. Small movements may be obtained by enemata, but the distention will not be influenced thereby, although the latter will be temporarily diminished by vomiting, washing out the stomach, or the expulsion of large quantities of gas *per os*. With duodenal and jejunal obstruction the vomiting is not faecal. When the obstruction is in the ileum the distention is central until the distended coils of small intestine overlap the colon; the vomiting becomes faecal finally.

If the obstruction is in the lower portion of the colon there may be tenesmus and bloody and mucous discharges. Some writers lay stress upon increase of indican in the urine. The differences between the extent of the tympanitic distention present in obstruction of the small intestine and that of obstruction in the colon, save very early in the former, are not sufficiently great to be diagnostic. Attempts to measure the capacity of the portion of the large intestine below the seat of obstruction, and thus form some estimate of the location of the latter when this is believed to be in the colon, are sometimes made, but, as a rule, with only indifferent success. The large intestine of the adult, if filled to the ileo-cæcal valve, will hold about six quarts. Since the fluid will not reach beyond this point, theoretically one should be able to estimate the seat of the obstruction in the colon by the amount of water which can be introduced. In the absence of accurate knowledge of the capacity of the colons of children and infants considerable danger would be invited by persistent efforts to fill the bowel, as rupture might take place, particularly after nutritive changes had occurred in its walls. Pressure from a height of three feet in an infant, and eight feet in an adult, is within the limits of safety. In order to eliminate the voluntary efforts at evacuation on the part of the patient the latter would have to be anaesthetized. To prevent the fluid from returning the buttocks should be pressed closely together about the injection-tube. The patient is to be placed upon the right side, or, better still, inverted. With all precautions the results may be misleading, since one-fourth of the amount supposed to represent the entire capacity of the large intestine to the ileo-cæcal valve has been introduced into the rectum alone. It is said to be

possible to demonstrate the arrival of the fluid in the cæcum by auscultation.

In considering the cause of the obstruction a knowledge of the proportion of cases in which the different forms of obstruction is found upon autopsy is useful. 35 per cent. of all cases are found to be due to intussusception, and about the same proportion to strangulation by bands, inflammatory adhesions, appendicular lesions, diverticuli, and true internal hernia. Of the remaining 30 per cent. fully one-half are due to volvulus, 8 per cent. to obstructions by abnormal contents or foreign bodies, of which gall-stones are the most frequent, and 6 per cent. to tumors, cicatricial contractions, and strictures from neoplasms of the bowel-wall.

If the anatomical diagnosis can be assured and the large intestine determined to be the seat of the obstruction, about one-half of the cases will be found to be due to intussusception. Volvulus is next in frequency (30 per cent.), the remainder being accredited to tumor-pressure and strictures from morbid growths in the bowel-wall. If in the small intestine, about three-fourths of all cases occurring in this locality are due to strangulation. Next in frequency comes obstruction by gall-stones (14 per cent.). Volvulus is still less frequently met with in this locality, although cases are occasionally observed. Owing to the greater mobility of the small intestine occlusion from tumor-pressure is scarcely ever observed. About 1 per cent. of the cases of obstruction about the immediate neighborhood of the ileo-cæcal valve are due to stricture.

Volvulus rarely occurs under forty, and intussusception over thirty. The latter is much more likely to be present in children, and, with its abdominal tumor, bloody stools, and rectal tenesmus is much more easily recognized than any of the other forms, save only cancer, which is essentially a disease of middle adult and advanced life. 75 per cent. of the cases of intussusception occur at or near the ileo-cæcal junction, and 50 per cent. of the cases of volvulus are found near the sigmoid flexure. Stricture due to malignant disease as well as from other causes is likewise most frequently found at or below the sigmoid, and may sometimes be felt by digital examination. Twists at this point do not usually convey any definite information to the examining finger.

VOMITING.—Information may be derived from a study of the symptom vomiting. In obstruction in the duodenum and jejunum this may occur early, but is not fæcal in character. If in the ileum or at the lower end of the small intestine, it occurs early, is severe and persistent, and becomes fæcal only later on in the attack. If in the large intestine it is longer delayed, is less severe, and may not become fæcal until later, if at all.

PAIN.—The pain, in strangulation, is an early and prominent



symptom as compared with the other forms of obstruction. The peritonitis which follows volvulus is more sudden in its onset and spreads more rapidly than in the other forms. In strangulation this occurs later in the case, and may be absent altogether, the patient dying from toxæmia of intestinal origin.

**DISTENTION.**—In general peritonitis the bowel is greatly inflated from paralysis of peristalsis, and immobile as a whole. In strangulation and volvulus the involved portion of the bowel alone is inflated at first, and its mesentery being fixed mechanically at the point of constriction, this portion is free from peristaltic movement. The efferent or leading-off portion is contracted, while the afferent or leading-to portion, in case of strangulation low down, fills up slowly. In strangulation high up the afferent portion becomes more rapidly distended. In cases of obstruction by plugging the distention gradually decreases in volume as we approach the stomach. In addition to this there is not such pronounced diffused interference with peristalsis, the different intestinal coils filling and emptying themselves repeatedly.

Sixty-eight per cent. of all cases of strangulation give a previous history of peritonitis, and in 12 per cent. there have occurred some form of intestinal disturbances attributable to interference with the function of the tube, if, indeed, they are not made out to be real attacks of obstruction, more or less complete.

Symptoms pointing to inflammatory processes in the region of the gall-bladder and duodenum may sometimes be obtained as a part of the history in cases of obstruction from impacted gall-stone. Preceding biliary colic and icterus are only valuable as suggesting the formation of calculi. Gall-stones sufficiently large to cause obstruction usually pass directly into the bowel from the gall-bladder by perforation.

The after-course of the case following the entrance of the gall-stone into the intestine can but rarely furnish information bearing upon the occurrence or seat of its arrest.

Early vomiting and prostration are the significant features of an obstructive lesion in the small intestine, while tenesmus and bloody stools are the striking characteristics of that of the large intestine. The possibility of a diaphragmatic hernia—with its history of an injury, distended and tympanitic area upon one-half of the thorax, restricted respiratory movements, feeble breath-sounds, and diminished vocal fremitus and vocal resonance—occurring coincidently with symptoms of intestinal obstruction, should not be overlooked.

Fæcal obstruction usually furnishes a history of subacute onset and chronic course. The insidiousness of its development may throw the practitioner off his guard. Its recognition depends mainly upon

the demonstrated presence of a tumor with irregular surfaces lying in the course of the intestine. It occurs more frequently in the large than in the small intestine, and above the ileo-cæcal valve or sigmoid flexure.

Finally, the possibility of the occurrence of intestinal obstruction from more than one cause should be borne in mind. Thus, the starting-point of a faecal obstruction may be a cicatricial contraction from an old ulceration, and a stricture originating in malignant disease may not have encroached sufficiently upon the lumen of the gut to give rise to obstructive symptoms until it serves to arrest the passage of a large gall-stone. The latter occurred in a case operated upon by myself.

In general terms it may be stated that the more violent the onset, the more severe and persistent the pain, and the more profound the collapse, the greater are the probabilities that either strangulation or volvulus is present.

So far as the success or failure to differentiate between the conditions causing the obstruction and its bearing upon the indications for operation is concerned, it may be said that such differentiation is frequently impossible and always unnecessary. In all cases the diagnosis can be made by exploratory abdominal section, and this course is imperatively demanded, both from the diagnostic and therapeutic standpoint.

**Prognosis.**—In obstruction from causes residing within the gut, such as foreign bodies, gall-stones, faecal impaction, etc., as well as occlusion of the gut from tumor-pressure and the presence of the products of inflammation, the prognosis is more favorable than when the obstruction is due to strangulation from bands, angulation, or rotation. The mortality in all forms, however, unless operated upon early, is high. Operative interference is not usually undertaken until the patient's strength is exhausted or general peritonitis has supervened, with the result that an undeserved opprobrium is cast upon the surgeon's work. The following is illustrative of this:

Lobstein<sup>1</sup> collected 60 cases of obstruction due to gall-stones not operated upon. Of these, 29 died unrelieved; in the remaining 31 the gall-stone passed on and the patients finally recovered. On the other hand, out of 31 cases turned over to the surgeon for operation 19 died. From Lobstein's statement of the condition of these patients when they came into the surgeon's hands, it is apparent that they belonged with the necessarily fatal cases without interference of the first collection. On the other hand, the fact that they recovered is evidence that the 31 favorable cases, in which the gall-stone was finally passed, were cases of incomplete rather than of complete obstruction.

<sup>1</sup> *Beiträge zur klin. Chirurgie*, Bd. iii. Th. 2.



Further, the results obtained in the second collection, viz. 12 out of 31 cases, are to be considered as extraordinarily favorable, since, between pre-existing septic inflammatory conditions, prostration, and the existence of complete obstruction, the majority were beyond hope when the operative procedure was instituted.

The occurrence of strangulation is the important feature in acute cases, the fate of the bowel itself being of far greater importance than the mere occurrence of obstruction to the passage of faecal matter.

L. Rehn<sup>1</sup> obtained 10 recoveries out of 13 cases of acute intestinal obstruction by early operation. Of these the majority were cases of strangulation and torsion. One was a case of flexion due to the presence of a suppurative collection, the symptoms disappearing after evacuation of the pus. One was a case of displacement of the sigmoid flexure due to the presence of the foetal sac in a case of abdominal pregnancy.

All cases of hyperacute intestinal obstruction, *i. e.* those involving interference with the function of the bowel itself and causing nutritive and destructive changes in its walls, invariably prove fatal without operation. The prognosis in operated cases will largely depend upon the promptness with which the abdomen is opened and the bowel released from its dangerous environment, the damage inflicted upon the intestine and mesentery, and the effects of this upon the system at large.

#### TREATMENT.

**Abdominal Section for Intestinal Obstruction.**—Inasmuch as the incision must be largely of an explorative character in acute obstruction, for the reason that it will rarely occur that a positive anatomical diagnosis will have been made with sufficient certainty to warrant the surgeon in making his incision directly over the supposed site of the obstruction, this is usually made in the median line, and extends from the umbilicus above to the ensiform process, or below to the pubis. The incision is made generally by preference through the linea alba; it may pass through either one or the other recti muscles. By some this latter is considered an advantage, the muscular cicatrix giving rise to less liability of ventral hernia. Great care must be exercised as the peritoneum is reached, if there be much distention. This structure must be held well away from the abdominal contents while a small opening is made. This is enlarged without releasing the peritoneum until the index-finger of the left hand can be introduced. The further enlargement of the opening can now be done by means of the blunt scissors or knife, using the finger as a guide and exercising great care that neither the omentum or intestine above nor the bladder below is wounded. One or two

<sup>1</sup> *Archiv für klin. Chirurgie*, Ed. xliii. Th. 3, 4.

vessels may require clamping for a short time; these do not, as a rule, require ligature.

As soon as the cavity of the peritoneum is opened, hot towels or gauze compresses should be at hand for covering the distended coils of intestine and supporting these as they tend to escape externally. The sigmoid flexure and the ileo-cæcal region are first subjected to an inquiry as to the existence of a twist at the site of the former, or intussusception, gall-stone obstruction, or neoplasm at the site of the latter. The next object must be to search for collapsed small intestine, which may be generally found by following the distended coils in the direction in which the distention increases, this leading to the point of obstruction. Finally, collapsed gut will be found, and when this has once been identified it is but a question of short search between the distended coil above and the flattened intestine below before the place of obstruction is identified. The character of the obstructing agent is now determined and measures taken to release the involved intestine if the obstruction be from without the gut; remove the offending substance if from within; resect the intestine if the obstruction resides in its walls, or if the latter have become gangrenous from prolonged constriction or torsion of the vessels of supply in the mesentery; connect together the portion below with that above the obstruction by means of either lateral or circular enterorrhaphy following resection, or, it being found impossible to resect the diseased parts, the application of intestinal anastomosis and elimination of the diseased portion by either lateral implantation of a portion of intestine from above into healthy intestine below the obstruction, following section at the former point, and closure of the diseased portion of the bowel, or flat-wise approximation of two bowel-surfaces with communicating slits in such manner as to "short circuit" the intestine and carry the fæcal current around the point of obstruction.

Finally, under circumstances demanding that the operation be brought to a termination as quickly as possible the operator may be compelled to resort to the formation of an artificial anus for the purpose of temporarily relieving the patient, leaving it for the future to decide the best method, if any, of relieving the patient from his unfortunate environment. Under circumstances of excessive distention these manipulations will often be seriously embarrassed, and it will be found necessary to empty the coils either by aspiration or incision.

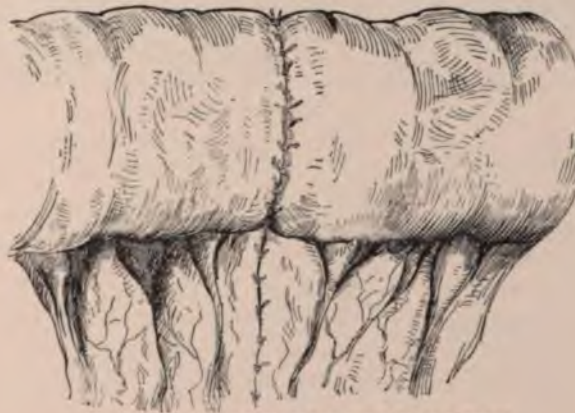
When general peritonitis is present this must be treated upon the lines laid down in the chapter devoted to that disease. In the absence of this complication, and if infection has been avoided during the operation, the abdomen may be closed at once. If fæcal extravasation has occurred, the parts contaminated must be cleansed as rapidly as possible by wiping out with gauze. The question of flushing the

abdominal cavity is still *sub judice*. If resorted to, a six-tenths of 1 per cent. solution of chloride of sodium in sterilized water is to be employed. A teaspoonful of common salt to the quart will be sufficiently accurate when the solution must be improvised.

RESECTION OF THE INTESTINE.—The diseased portion of the bowel must be completely excised, together with a V-shaped piece of the mesentery, and the latter tied in sections. The adjacent portions of bowel must be emptied and cleansed as soon as divided. The further escape of faecal matter into the field of operation must be guarded against, either by the application of a suitable clamp, by passing a narrow strip of gauze through the mesentery, *well away from the attachment of the latter to the bowel*, lest some of the blood-supply to the latter be interfered with, and twisted to constrict the bowel slightly, or by the thumbs and fingers of an assistant making compression. The latter is always to be preferred when available.

The suture of the divided bowel should always begin at the mesentery, and it is here that the greatest care is necessary in order to secure against leakage. After this has been done the suturing is to be completed. The interrupted Lembert suture of silk should be employed. Continuous Lembert suturing is not to be used, for the reason that it has a tendency to produce a purse-string effect and cause constriction of the bowel at this point. When completed the parts should present the appearance shown in Fig. 287.

FIG. 287.



Appearance of the parts when completely sutured.

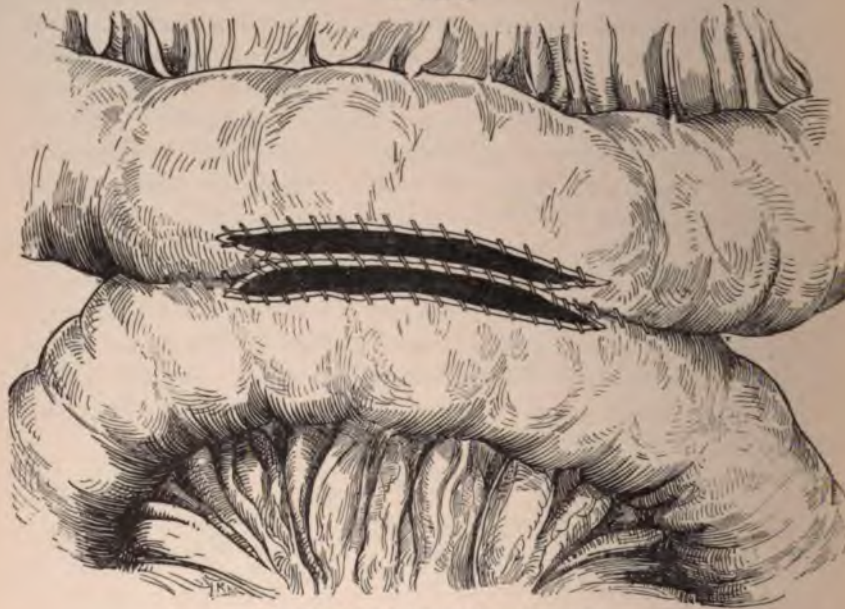
Since extravasation and general peritonitis is the most frequent cause of death after the operation, it is wise to leave a narrow strip of gauze in contact with the suture-line, and led out of the abdominal wound, to provide against the accidental giving way of a stitch; this is to be removed after forty-eight hours. As additional security Senn



sutures a portion of the great omentum over the entire row of sutures in circular enterorrhaphy, thus completely encircling the suture-line by a detached omental graft an inch wide.

Lateral anastomosis after resection has no advantages over circular enterorrhaphy as just described. Even with the most rapid technique yet devised it will be necessary to close the divided ends of the bowel, which, if properly done, will probably consume quite as much time

FIG. 288.



The first stage in intestinal anastomosis.

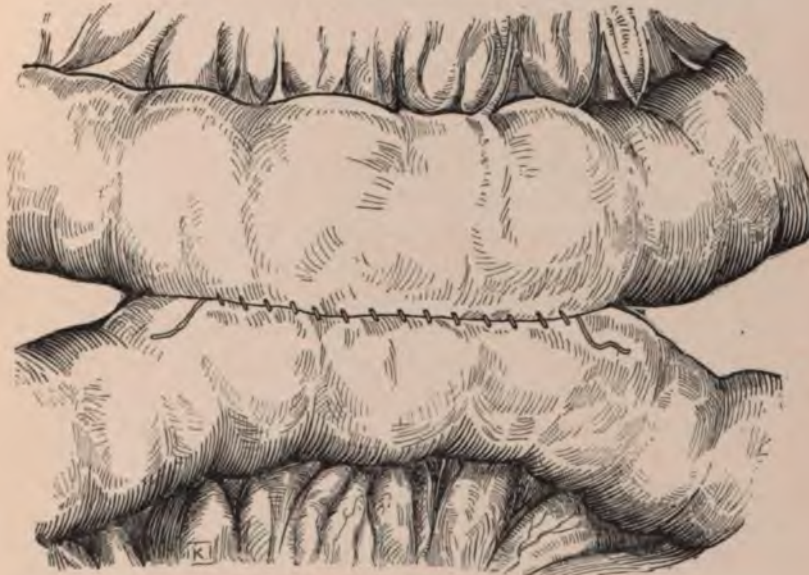
as that which has been saved by the application of the plates of bone after Senn, or the potato-plates of Dawbarn.

*Intestinal Anastomosis.*—This operation is designed to unite portions of the intestinal tract more or less distant from each other, without the necessity of resecting an intervening portion of the gut. It is a useful expedient in cases in which the patient's condition is such as to demand haste, as well as under circumstances of extensive disease where resection cannot be done. Its largest field of usefulness is in the small intestine, a coil as near as possible to the obstruction and above the latter being selected for the purpose, and applied to the coil immediately below. The slits of communication should be made diametrically opposite to the mesenteric attachments, and, to allow for subsequent contraction, which always occurs, the opening should be not less than two inches in length. The suturing should be done in two stages, the first consisting of uniting the edges farthest



from the operator by a continuous stitch, as shown in Fig. 288. In cases demanding urgent haste the hemming of the cut edges, as shown in the drawing, may be omitted. The second stage consists of uniting the edges nearest to the operator by another continuous suture, and finally applying a second suture-line all the way around the approximation-line (Fig. 289).

FIG. 289.



The second or final stage in intestinal anastomosis.

The method of intestinal anastomosis by suture is far safer than by mechanical devices, but the time required is somewhat longer.

In all operative attacks upon the intestines the parts to be operated upon must be brought outside of the abdominal cavity when possible, and the remainder of the viscera protected by warm towels or large gauze compresses during the manipulation.

In closing the abdominal wound following this, as well as all operations involving the cavity of the peritoneum through the anterior abdominal wall, it is essential that the parts should be properly approximated, and primary union obtained, in order to avoid the subsequent development of surgical hernia.



## OBSTRUCTION OF THE INTESTINES.

BY EDWARD MARTIN, M. D.

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OBSTRUCTION of the intestines may be caused not only by the mechanical closure of the lumen of the bowel, such as occurs in case of strangulated hernia, but also by certain pathological states, such as peritonitis or enteritis, which by occasioning a paretic condition of the muscular coats of the intestinal wall favors stasis, with resultant fermentation of the complex organic compounds contained in the alimentary canal and the development of typical symptoms of obstruction, accompanied by those of either inflammation or of septic absorption.

Clinically, cases of intestinal obstruction are classed as acute or chronic, depending upon the violence of the onset and the severity of the course of the disease. No sharp distinction can be drawn between the two, and each is liable to merge into the other.

Acute intestinal obstruction may be due to congenital malformation; to invagination or telescoping of one portion of the bowel within another; to internal strangulation by bands, diverticula, membranous adhesions, constrictions through apertures, or attachments of organs not in themselves diseased; to volvulus or twisting of the bowel; to impaction of foreign bodies; and to intestinal paralysis and distension.

Chronic obstruction is commonly due to stricture, to neoplasms, to pressure external to the bowel, or to impaction of faecal masses.

### CONGENITAL MALFORMATION.<sup>1</sup>

Narrowing or obliteration of the intestinal tract at birth may be found in any portion of the small or large gut. In the great majority of cases observed it is only in the region of the rectum or anus. Other seats of preference are the duodenum, the neighborhood of the ileo-caecal valve, and the sigmoid flexure.

As observed in the lower bowel, this deformity may appear as a narrowing (partial occlusion), atresia (complete occlusion), or absence (imperforation) of the anus, of the rectum, or of both these structures. At times there is observed a stenosed opening in an abnormal position.

A careful statistical study of cases of congenital malformation shows

<sup>1</sup> For further consideration of this subject see article on Rectal Diseases.

that it is multiple in 28 per cent. of all cases, and that in 10 per cent. it is of such a nature as to be mechanically irremediable.

The symptoms of congenital malformation causing obstruction of the bowel are the same as those from obstruction dependent on any other cause. Shortly after birth fæcal vomiting, pain, and tympany, together with absence of evacuation from the bowel, will sufficiently indicate the nature of the attack, even though the malformation cannot be detected upon inspection.

The treatment of this condition is surgical. When atresia depends upon a thin membrane occluding the anus, a simple incision will give relief.

For imperforate anus the coccyx should be excised, and the bowel should be sought for by cutting upward and backward. The incision should not be carried deeper than an inch and a half at the most. If the bowel is found, it should be brought down to the skin wound and stitched in the position that the anus would normally occupy.

If the rectum cannot be found by this incision, the cut for left inguinal colotomy should be made. If the finger passed into the peritoneal cavity finds that the perineal incision can be safely deepened, with a condition of the rectum which will allow of its being drawn through this opening, the operation first undertaken should be completed and the inguinal incision should be closed. If, however, the conditions are such that an attempt to form a new anus is inadmissible—as, for instance, when there is complete absence of the rectum and atresia of the sigmoid flexure—left inguinal colotomy should be performed. The gut should be held in place, after suture of the skin to the parietal peritoneum, by a piece of rubber catheter passed across the wound and through the mesentery close to the bowel. Stitches should of course be inserted. Before securing the bowel in this way a digital examination should be made in the regions of the ileo-cæcal valve and duodenum, since malformation is frequently multiple, and these are the commonest seats of imperfect or arrested development.

If the obstruction does not depend upon atresia of the anus or rectum, exploratory abdominal section should be performed in the hope of finding the seat of trouble, and of remedying it by excision and end-to-end suture, lateral anastomosis, colostomy, or enterostomy.

#### INTUSSUSCEPTION.

The term intussusception implies that one portion of the gut is invaginated or turned within the lumen of another part immediately adjoining. This forms a tumor made up of three layers of bowel. The *intussusceptum* is composed of the entering and returning layers, while the receiving layer is called the *intussusciens* or *sheath*. Usually the



upper segment of the gut is received into the lower. "Retrograde intussusception" is a term applied to a condition the reverse of this.

The invagination may be *enteric*, involving the small intestines only. It may be *ileo-cæcal*: in this form the ileum and cæcum, together with the ileo-cæcal valve, are turned into the colon. It may be *ileo-colic*: in this form the ileum is prolapsed through the ileo-cæcal valve, the latter retaining its proper relative position until, as a result of secondary changes, it, together with the cæcum, is more or less displaced. It may be *colic*, in which case it involves the colon only. Or it may be *rectal*, the seat of trouble being situated entirely within the rectum.

Invagination in itself does not entirely occlude the lumen of the bowel. Complete obstruction, however, frequently results from swelling of the involved area, dependent upon constriction at the neck of the intussusceptum, and from lodgement of fæces. As a result of the inflammation excited by the constriction the serous surfaces of the entering and returning layers of the invagination frequently become adherent.

Invagination is one of the commonest causes of intestinal obstruction. In the first year of life obstruction from invagination is more frequent than from the sum of all the other causes occasioning this condition. After the fifth year intussusception becomes comparatively rare till the fortieth or fiftieth year, when it again increases in frequency of occurrence. The ileo-cæcal region is the favorite seat of invagination.

The onset of intussusception is characterized by sudden violent pain. After some time, usually a few hours in children, the pain ceases as suddenly as it commenced, and there is an interval of quiet. This is followed by a return of pain, the paroxysms becoming more violent and prolonged and the intervals becoming less marked as the disease progresses. Vomiting is an almost constant symptom. Its severity bears relation to the degree of obstruction rather than to its seat. Blood-stained mucous evacuations are rarely absent. In children diarrhœa is common throughout the whole course of the case. In connection with the muco-sanguinolent evacuations, tenesmus or straining is very marked. In more than half the cases a tumor can be felt in the left iliac region or by the finger passed into the anus. If this tumor is carefully observed, it may be found to have an erectile and a vermicular motion.

In the chronic form of invagination there may be no symptoms other than recurring paroxysms of pain, meteorism, and obstructive symptoms.

The mortality of intussusception as treated by the expectant method is about 74 per cent. The chances for life are best when the disease occurs at about the age of puberty. Sloughing and discharge of the

intussusception are favorable signs, since 41 per cent. of cases in which this occurs recover.

The treatment for intussusception may be either medical or surgical. The statistics of abdominal section for invagination give the mortality percentage as 75.4. There can be little doubt that in reality it is even higher than this, since there is a natural tendency to report only favorable cases. Abdominal section has usually been considered only after days spent in repeated and ineffectual efforts at reduction, when the patient's strength is far spent and immediate death is staring him in the face. Under these circumstances it is unfair to compare the statistics of operative cases with those treated expectantly, yet the mortality against the surgeon is less than 2 per cent.

Considering the class of cases in which section has been employed, any percentage of success would be encouraging; if resorted to when all conditions are favorable—that is, immediately after one thorough effort to accomplish reduction without operation—the percentage of recovery would probably be so high that even the most conservative would be disposed to recommend this form of treatment.

The medical treatment of intussusception is exceedingly simple. Morphine and atropine may be administered hypodermically in quantities sufficient to relieve the acute suffering. Lavage of the stomach may be practised if the vomiting is frequent and exhausting, and particularly if the eructated matter is very offensive. As a mild antiseptic boric-acid solution may be employed in place of water alone.

The pathology of intussusception shows that disinvagination becomes difficult in direct proportion to the length of time which has elapsed since the onset of symptoms; hence every hour that treatment is delayed diminishes the chances of success. Provided the case is not of such long standing that tight adhesions have probably made reduction impossible, or strangulation has produced a partial necrosis, ether should be administered to its full surgical extent, producing complete relaxation of the muscular system. By means of a fountain syringe a 0.7 per cent. saline solution at a temperature of 105° F. should be slowly forced into the rectum under a pressure of not over two pounds to the inch. (Elevation of the reservoir four feet.) The liquid is prevented from running out of the bowel by means of a shoulder upon the injection-pipe, readily made by wrapping the latter with a narrow bandage. The abdomen should be gently kneaded. This treatment should be continued for fifteen minutes, the pressure being gradually increased till it reaches four pounds. This is obtained by elevating the reservoir eight feet. This trial at forced reduction must be thorough and final. There should be no idea that it is to be repeated with more care and attention to detail.

If there is a distinct tumor, the probable success of the method



above detailed will be denoted by its disappearance ; the positive failure by the tumor occupying the same position as before treatment and retaining its full size. In the latter case the surgeon should proceed to operate at once, while the patient is still under the influence of the anæsthetic. In the majority of cases the success of this forced injection can be determined only by allowing the patient to come out of his ether ; the progress of symptoms will then quickly decide as to whether a cure has been effected or not. Section should be performed the moment it becomes clear that invagination still persists.

When the severity of the symptoms and the amount of obstruction denote marked strangulation, and the patient has not been seen for several days from the onset of the attack, abdominal section should be the first resort.

If there is a tumor, incision should be made over it. In the absence of this sign the opening should be made in the linea alba below the umbilicus. When the invagination is found, it should be reduced by grasping the tumor at its lowest part and endeavoring by gentle continued pressure to reduce the venous congestion ; then by traction from above and pressure from below the reduction will be much facilitated. If adhesions are formed about the neck, these may be broken up by a probe passed between the entering and returning layer and carried around the circumference of the bowel. If the adhesions are so tight that restoration of the gut to its normal position is impossible, enterostomy and the formation of an artificial anus are justified, provided the patient's condition is such that further operative interference will not be tolerated. The operation of choice, however, consists in suturing the intussusciens to the intussusceptum at the ring of external contact, making a two-inch longitudinal incision through the intussusciens, dividing through this cut the intussusceptum and pushing the portion cut away down along the colon till it can be delivered through the anus, sewing together the cut borders of the entering and returning layers of the intussusciens by a continuous suture, and finally closing the longitudinal incision in the intussusceptum by a Lembert suture. Spontaneous resolution may subsequently take place with complete restoration of the continuity of the alimentary canal.

#### INTERNAL STRANGULATION.

Next to intussusception, internal strangulation ranks in order of frequency as a cause of intestinal obstruction. It commonly occurs in males between the thirtieth and fortieth years, and is in the great majority of cases due to the remains of a former peritonitis. It may be due to isolated peritoneal adhesions, to cords formed from the

omentum, to Meckel's diverticulum, to normal structures abnormally attached, or to slipping of the gut through slits and apertures.

Internal strangulation may be sudden or gradual in development. Usually without cause there is sudden agonizing pain located at the umbilicus; this pain is constant, but has paroxysmal aggravations. There is vomiting; this is constant, gives no relief to the patient and becomes fecal about the third day. There is constipation, which becomes absolute as soon as the bowel below the seat of obstruction is emptied. There are often localized tenderness and percussion dullness which when present denote with some certainty the position of the strangulated bowel. There is violent peristalsis, and meteorism develops slowly. The pulse becomes rapid and weak. Unless inflammation develops the temperature remains about normal or a little below. The urine is greatly diminished in quantity and contains albumin.

The treatment of internal strangulation is obviously operative. Although a cure is possible, either by the rupture or absorption of the constricting band or by an intestinal anastomosis by ulceration, the result must be exceedingly rare when the condition of strangulation is fully established. Injection, massage, electricity, or any or all of the therapeutic means usually resorted to in cases of obstruction, can by the merest accident be of the slightest avail. In any case of obstruction characterized by such fulminant symptoms as are common in strangulation, abdominal section with the idea of mechanically removing the cause of obstruction should be the first resort.

At times the onset of the malady is signalled by most profound shock; this may demand treatment before operation can be performed. External heat, full doses of morphine and atropine administered hypodermically, and whiskey by the bowel, 4 ounces diluted with eight times that quantity of hot water, offer the best hope of promoting reaction. Should the shock not yield to this treatment, and should the symptoms be steadily progressive, anaesthesia should be produced by the least possible quantity of ether, the abdomen opened, and a hurried search made for the seat of constriction. Such exploratory section is often possible under infiltration anaesthesia with eucaine or cocaine. The patient should be relieved as rapidly as possible, and the peritoneal cavity should be flushed with hot saline solutions. If under these circumstances—that is, operation during profound shock—the seat of obstruction cannot be found, or, if found, the obstruction cannot be readily overcome, an enterostomy is clearly indicated.

When the patient is in good condition a free parietal incision should be made: the congestion and discoloration of the strangulated bowel, the distention above the point of occlusion, and the empty, flaccid condition of the intestine below will each serve as valuable guides to



seat of trouble. Not only should the constriction be relieved, but the constricting bands should be entirely removed. Thus, if the appendix is the seat of trouble, its ligation and complete removal are indicated.

It is a matter of prime importance after relief of the strangulation to evacuate the distended and paralyzed bowel. This may be accomplished by means of one or more incisions, which can be closed readily by means of the Lembert suture. These sutures are most readily inserted before the incisions are made. When the obstruction is due to the matting together of a number of intestinal coils, unless the adhesions can be readily broken up the safety of the patient will be consulted best by performing either an intestinal anastomosis between the healthy bowel leading to the adherent coils and that leading from them, or by forming an artificial anus. Constant peristaltic and respiratory intra-abdominal motion may ultimately cause the complete disappearance of extensive intestinal or omental adhesions.

In cases of strangulation alimentation should be administered by the rectum, and stimulants used freely either by the rectum or subcutaneously. The stomach should be washed out thoroughly before operation, this treatment being repeated in proportion to the severity of the vomiting. Absolutely nothing should be given by the mouth. After the cause of the constriction has been removed a saline purge acts as a valuable aid in restoring tone to the parietic bowel. McCosh has suggested giving this through the bowel incision made for the purpose of relieving distention and evacuating the intestinal contents. Pneumonia is a common sequel of strangulation.

#### VOLVULUS.

Twisting of the bowel is the cause of intestinal obstruction in about 3 per cent. of all cases. The twist is usually about the mesentery as an axis. This form of intestinal obstruction occurs most commonly in men past middle life who have long suffered from constipation. The sigmoid flexure is most frequently affected. Even in the form characterized by the intertwining of several loops it is with the sigmoid flexure that the small bowel usually becomes entangled.

A long mesentery with a comparatively narrow attachment is necessary for the development of the twist. This may be congenital; more commonly it is acquired, years of constipation so dragging upon the sigmoid flexure that it is greatly elongated, the two extremities being constantly more approximated until the condition suitable to the development of the trouble obtains.

Venous congestion plays an important part in the changes dependent upon volvulus. The involved loop becomes engorged with blood and immensely distended from decomposition of its contents. Peritonitis is very frequently developed. The constricted portion of the bowel

becomes gangrenous. As in other forms of intestinal obstruction, obstinate constipation, vomiting, and abdominal distension are present. The disease has no distinctly diagnostic features, but should be suspected when in a man at or past middle age, of constipated habit, severe but not agonizing pain, attended with symptoms of moderate shock, inaugurate an illness characterized by moderate bilious vomiting, absolute constipation, and great abdominal distension, with tenderness appearing shortly. Tenesmus and a history of distension, first appearing in the region of the colon, would still further strengthen the diagnosis. The quantity of fluid which could be injected through the anus would necessarily be limited.

The treatment for obstruction from volvulus is purely surgical. Purgatives are as evil in their effects as in other forms of obstruction, and their administration has often been the starting-point for the onset of acute general peritonitis. A gradual forced injection of water with the patient in the knee-elbow position may possibly accomplish reduction before the bowel is fixed in its abnormal position by distension, congestion, and peritonitis.

If the diagnosis is fully established, no time should be lost in opening the belly, untwisting the bowel segment, and evacuating its contents.

Resection and end-to-end suture or enterotomy may be necessitated by gangrene and by the impossibility of retaining the bowel in a normal position.

Lavage of the stomach, the avoidance of food by the mouth, and in general the treatment applicable to other forms of obstruction are valuable in cases of volvulus.

#### OBSTRUCTION FROM FOREIGN BODIES.

Under this heading are considered not only those cases of obstruction due to foreign bodies which when swallowed lodge in some portion of the alimentary canal and mechanically block the onward passage of its contents, but also those cases in which acute symptoms are produced by intestinal concretions, enteroliths, gall-stones, hydatids, or any mass sufficiently large to block the bowel.

A foreign body which has passed into the stomach, if of large size, will probably be arrested in that viscus. Should it pass the pylorus, it will probably lodge in the cæcum. If the cæcum is safely passed, its final evacuation is not yet assured, since the rectum is also a favorite lodging-place for these bodies.

Large numbers of small bodies may be swallowed which individually can readily pass through the bowel, but which taken in great quantity may form a conglomeration sufficiently large to produce occlusion. Cherry-stones frequently act in this way, and cases are on

record where concentric masses of hair filling the stomach and small intestines have caused death from obstruction.

In the majority of cases the œsophagus is an accurate gauge as to the possibility of a body passing the entire length of the alimentary canal, the chances being largely in favor of spontaneous discharge of whatever has passed into the stomach through the cardiac valve. Bonet states that Charles II. of England placed a razor and two knives in the mouth of a professional sword-swallower; they were swallowed, and discharged *per anum* upon the third day.

The diagnosis of obstruction from foreign bodies will usually depend upon the history of the case. If the symptoms are caused by the lodgment of a gall-stone in the bowel, there can commonly be elicited a previous record of sharp colicky pain, of partial obstruction, of vomiting, and of some local peritonitis about the region of the liver. In obstruction by foreign bodies the distension is slight; the amount of systemic shock is far less, and the duration of the attack is somewhat longer, than usually obtains in other forms of obstruction. The symptoms frequently denote only partial blocking, the vomiting being moderate in amount and not stercoraceous, and the constipation not being absolute. Except in the case of enteroliths and very large foreign bodies a tumor can rarely be felt.

When obstruction is fully developed and the diagnosis of a foreign body in the causative rôle fairly established, an abdominal section with removal of the foreign body is indicated. If the lodgment is in the rectum, the body should of course be removed through the anus. If operation is absolutely refused, the controlling of pain and violent peristalsis by morphine hypodermically, deep-forced enemata, gentle massage, and feeding by the rectum may be tried. After acute obstructive symptoms have passed off, a continued gentle action upon the bowel, such as is produced by a pill composed of aloin, strychnine, and belladonna, is indicated.

#### INTESTINAL PARALYSIS.

Intestinal obstruction may develop suddenly, and may run to a fatal issue, yet at the autopsy there may be no sufficient cause found for the symptoms observed during life. In some of these cases the muscular coat of the bowel is found intact. The symptoms may depend upon reflex action or upon a general condition of the nervous system; thus severe injury to the testicle, operations about the rectum, or general hysteria have all been accompanied by symptoms of acute intestinal obstruction. These symptoms are usually of an evanescent character, and are promptly relieved by attention to the condition which excited the reflex.

After abdominal wounds, however, tedious laparotomies, or severe



contusions in the abdominal region, there may be developed a condition of intestinal paralysis which quickly leads to obstruction, to great distension, and to death from either septic absorption, exhaustion, or peritonitis.

Inflammation or ulceration of the mucous membrane sometimes causes cessation of peristalsis and resultant obstructive symptoms. Denarié gives the history of a case perishing after nearly two weeks of obstinate constipation. There was great meteorism and systemic depression, but no pain or fever. At the autopsy a rodent ulcer of the descending colon was found; beyond this nothing pathological was observed in connection with the intestinal canal, excepting great distension. It is probable that in the great majority of these cases of paralysis the symptoms are dependent upon extension of irritation or inflammation from the mucous or peritoneal coats of the bowel to the muscular layer.

Fatty degeneration of the muscular coat of the bowel may act as a direct cause of intestinal obstruction and death. In one case examined by Jordan the microscope confirmed the fatty change which the muscular fibres were supposed to have undergone. The patients who exhibit this degeneration are those who suffer from fatty changes in other parts of the body. The ultimate paralysis is commonly produced by flatulent distension, but any injury or operation about the peritoneal cavity or pelvis may determine the incompetency of the already weakened muscular fibres. It is universally recognized that in very fat patients symptoms of intestinal obstruction are peculiarly prone to occur after abdominal section.

A purely neurotic paralytic obstruction—such, for instance, as is dependent upon hysteria—would be marked by irregularity in course and the characteristic manifestations of disordered nerve-action. When observed it has been in the persons of hysterical females. Although such patients may suffer from faecal vomiting, there may be complete absence of tympany. The reflex paralysis has also been characterized by short duration and sudden disappearance of symptoms.

The paralysis dependent upon abdominal injury or visceral exposure is that most commonly encountered, since it is this form which occurs after operation. Following abdominal section, the course of the patient may seem satisfactory for from one to three days, when a condition of partial collapse sets in. Unless the patient is very closely watched the onset seems sudden. The pulse is rapid and running, the belly quickly becomes greatly distended, there is vomiting of ingested food or bilious matter, and there is absolute constipation. Pain, though severe at times, does not reach the agonizing intensity characteristic of strangulation. There is no marked tenderness and no charac-



teristic alteration in the temperature. Death seems to occur from heart failure.

Paralytic obstruction dependent upon degenerative changes in the muscular layer of the bowels is usually observed in patients who are advanced in years, and who show atheromatous or fatty change in other parts of the body. There is a preceding history of long constipation, and possibly of occasional attacks of temporary obstruction. The acute onset is usually preceded by obstinate constipation, symptoms of obstruction developing after the taking of an active purge. The symptoms are the same as those characteristic of intestinal paralysis from other causes.

It is particularly in cases of intestinal paralysis that salines have won their reputation. Administered in the first stage, before paralysis has fairly developed, they seem to have the power of re-establishing peristalsis, of restoring tone to the muscular coat of the bowel, and of sweeping from the intestinal tracts the partially-digested matter ripe for fermentation and putrefaction. That the paralysis dependent upon a beginning typhlitis, salpingitis, or any form of local peritonitis has been many times avoided by the prompt administration of saline cathartics cannot for a moment be doubted. Salines, then, should be administered freely in the beginning of this form of obstruction.

If the distension has reached any great development and vomiting has set in, salines are no longer indicated. Absolutely nothing should be given by the mouth; lavage of the stomach should be practised; the rectal tube should be inserted to excite peristalsis and draw off wind from the rectum; the patient should be freely stimulated by whiskey *per rectum* or hypodermically; and the faradic current should be applied with one metal pole within the anus, the other being placed over the motor points of the abdominal muscles and full doses of strychnine should be given subcutaneously. Finally, if death threatens from septic absorption or over-distention, the abdomen should be opened, the bowel should be incised in as many places as evacuation of its gaseous and liquid contents requires, and an artificial anus formed. Should the patient recover from the acute attack, this opening will close spontaneously. The over-distention being relieved, there is a chance that the tonus of the muscles may be restored. There is but slight hope for spontaneous resolution when the meteorism reaches an extreme limit.

Where there is acute pain morphine administered hypodermically is of great service. Strychnine, pushed to its extreme physiological limit, may prove a valuable adjuvant in restoring tone to the paralyzed gut. Stimulating enemata, such as turpentine or asafetida, have at times seemed to accomplish good. Belladonna in full doses is also said to be effective. Other drugs are absolutely useless.

## CHRONIC OBSTRUCTION.

This form of obstruction is produced by any cause which occasions a gradual narrowing of the lumen of the bowel. Thus the shrinking of plastic lymph deposited upon the bowel-surface during acute inflammation, cicatricial contraction following ulceration or extrusion by sloughing of an intussusceptum, the gradual blocking caused by matting together of coils of the bowel, or the encroachment upon the lumen of the bowel by new growths, produce the symptoms of chronic obstruction. The commonest cause of chronic obstruction in patients past their fortieth year is cancer of the bowel. The bowel above the point of narrowing is commonly dilated and ulcerated. The amount of narrowing is not necessarily indicated by the severity of the symptoms, since frequently death occurs with an opening so large that it is difficult to imagine why the obstruction could not have been relieved.

Chronic obstruction is usually indicated by irregular attacks of colicky pain, noticed a few hours after eating and increasing in frequency. There is frequently vomiting. This is rarely copious, but may become faecal upon the supervention of an acute attack. Meteorism is not very well marked. Peristalsis can frequently be seen plainly through the abdominal wall. If a new growth causes the narrowing, in addition to the foregoing signs a tumor may be detected.

By careful dietetics and attention to producing regular alvine evacuation, preferably by enemata, operative treatment may be indefinitely postponed. A pill of aloin, strychnine, and belladonna is especially serviceable in promoting peristalsis and preventing accumulation of faeces. This, together with the deep enemata and gentle massage of the belly, is especially the treatment for cases due to faecal impaction.

When symptoms are progressive, operative interference must be advised, particularly before the onset of an acute attack. The patient is then in a fairly good condition, the surgeon is fully prepared, and a formal and complete operation can be performed with a prospect of success.

If the narrowing is caused by a cancer, the latter should be removed if possible, and the continuity of the gut be restored by lateral anastomosis. If the malignant growth cannot be removed, it should be either switched out of the direct alimentary tract by means of a lateral anastomosis of the bowel above and below the seat of trouble, or, as the most conservative operation in so far as life is concerned, an artificial anus should be formed.

If the narrowing is non-malignant, unless it can be remedied by direct interference it should be resected or excluded by lateral anastomosis.



Certainly in the vast majority of cases of acute intestinal obstruction it is absolutely impossible to determine the exact mechanical cause which is exciting symptoms. These are very much alike, from whatever cause the obstruction arises. In the preceding pages there has been given a brief review of the salient features of the various forms of obstruction and of the special treatment applicable to each form. It seems fitting that there should be a general review of the various methods of treatment proposed for the cure of this class of cases.

**Diet and Medication.**—Neither food nor drink should be given by the mouth during the continuance of acute obstructive symptoms. This is not merely because there can be no digestion and no absorption, but because by taking alimentation into the stomach fresh matter is supplied for decomposition and fresh impetus is given to the exhausting vomiting. In one case of acute obstruction I withheld food for six days. The patient recovered, showing no marked emaciation as the result of her long fast.

Beef peptonoids, peptonized milk and eggs, and stimulants should be administered by the rectum. The thirst may be relieved by gently injecting one pint of warm normal saline solution into the lower bowel every two hours. If the heart shows signs of flagging, especially if collapse threatens, by means of a fountain-syringe and a fine canula 3 ounces of whiskey, dissolved in 2 pints of warm sterile saline solution, may be thrown by gravity into the loose cellular tissue of the loins or the buttocks. By gentle friction over the seat of injection rapid absorption is obtained. Hypodermic injections of ether, frequently repeated, are peculiarly applicable to this condition. Digitalis does not give satisfactory results. Against heart failure whiskey is the mainstay, and must be pushed until its physiological effect is produced. The rectum may also be used for the absorption of whiskey, but in this case the drug should be diluted with at least six times its bulk of water, since acute inflammation of the mucous membrane has been produced by concentrated solution.

Opium and belladonna are indicated when pain becomes so intense and vomiting so frequently repeated that the patient's strength is rapidly exhausted. They should be given together, and preferably in the form of alkaloids by hypodermic injection.

Strychnine is of service in conditions of profound nervous shock and in parietic states of the bowel. To be of service it must be pushed till its physiological effect is produced.

Purgatives are to be avoided.

Intestinal antiseptics, such as salicylate of bismuth,  $\beta$ -naphthol, salol, and boric acid, may be employed if they do not increase the vomiting. They are particularly serviceable when given in the course of lavage.

**Lavage of the Stomach.**—This treatment, originally advocated

by Kussmaul, has received the highest clinical indorsement. Its effect is direct and readily understood. It mechanically removes a large quantity of putrid septic matter which otherwise would be slowly and laboriously regurgitated by violent muscular efforts, thus still further weakening an already debilitated patient. It assists Nature in her eliminative efforts, and almost without exception produces an immediate improvement in the patient's condition. Indeed, there is so great an amelioration of symptoms that this procedure is utterly condemned by some surgeons as producing, like opium, a seeming improvement not warranted by the condition of the bowel at the seat of obstruction, and thus leading to a postponement of operation.

In some cases it produces not only relief, but is absolutely curative; Mahnert reports several cases of cure. Even where death is inevitable it is productive of such relief that it may be employed if nausea and vomiting are well marked. Curschmann ranks washing of the stomach next to opium as a palliative and curative agent. Nothnäger and Gerster commend this procedure, as do all surgeons who have fairly tried it.

Either plain water may be used or normal saline solutions or mild antiseptic lotions. Since there is a patulous condition of the pylorus, the weak antiseptic solutions are particularly indicated, as by becoming mingled with the intestinal contents further fermentation is retarded or entirely prevented. These injections should always be made with hot solutions (106° F.), and should be repeated in accordance with the severity of the vomiting and the character of the eructated material.

**Enemata.**—In the use of enemata there is more confidence than in all the other palliative means of treatment combined. Though especially applicable to intussusception, paralysis may be benefited by the stimulus thus given to peristalsis. In chronic obstruction dependent upon impacted feces or upon narrowing in some portion of the colon the use of enemata is practically the only palliative measure which gives any hope of success.

In making these injections certain points of cardinal importance must be regarded. When the injection is given for the purpose of exciting peristalsis, as in the case of intestinal paralysis or fecal impaction, it should be administered as rapidly as possible, and should be either cold or very hot. Its beneficial effects will be favorably modified by the addition of turpentine, asafœtida, or other stimulating medication.

When the injection is given for the purpose of mechanically overcoming obstruction, as in the case of intussusception, the liquid should enter the bowel by a gradual, steady flow. The temperature of the injected liquid should not differ greatly from that of the body. The pressure should be uniform and long continued, starting at two pounds (elevation of the reservoir four feet), and if necessary gradually increas-



ing to four pounds (elevation of the reservoir eight feet). At the most not more than a quarter of an hour should be spent in attempting to force the liquid past the seat of obstruction.

The danger of rupturing the bowel must be borne in mind. In every case where beginning mortification is feared—that is, where the symptoms have been very acute and have lasted for upward of three days—the danger of forced injection is so great and its probable efficacy so slight that this procedure should give place to operation. Under any circumstances there is some risk in the employment of more than four pounds of pressure, though this is far within the bursting strain of normal gut.

In view of the many successful results following even imperfect attempts at this method, this risk is justifiable in suitable cases, provided preparations are made for immediate abdominal section should symptoms characteristic of rupture of the bowel appear. The first attempt at reduction by injection should be so thorough that the physician can feel assured that the particular case of obstruction under treatment is not amenable to this method of reduction. At the first effort the circumstances are all more favorable for cure than at any subsequent time, and more force and perseverance are justified. There are many recorded cases showing that second and third attempts at reduction have succeeded when the first failed; this, however, was undoubtedly due to the greater thoroughness with which the latter efforts were made. These forced enemata should always be made by means of the fountain syringe: it is impossible to gauge the amount of pressure exerted by the Davidson or other pumping syringe. I know of three cases where injections administered by the Davidson syringe resulted in rupture of the bowel and speedy death.

**Electricity.**—In paralytic distension and obstruction the use of electricity has been followed by brilliant results. Thus, Auffret records a case which entered the hospital with great abdominal pain, tenderness, meteorism, and bilious vomiting. Abdominal facies was marked, the thighs were flexed upon the body, the pain was located about the umbilicus, the dilated intestinal loops were clearly outlined through the parietes. The pulse was scarcely perceptible, the temperature was subnormal. The following day all the symptoms were exaggerated and death seemed inevitable. The poles of a faradic battery were placed, one over the abdominal parietes, the other within the rectum; the application was continued twenty minutes, and was carried to its maximum intensity, when the patient experienced a sudden jar, accompanied by a feeling of intestinal displacement. Immediately there was a free evacuation of gas and fecal matter. The patient rapidly convalesced.

When it is uncertain whether obstruction is caused by paralysis or

by mechanical blocking, the application of electricity by means of the faradic battery should be given one thorough trial, preferably by means of a metal electrode carried into the rectum, the sponge electrode being applied to the belly-wall. As a means of applying the current still more directly Heard advocates filling the rectum with saline solution and introducing the metal electrode into this.

It certainly cannot be claimed that even the majority of cases of paralytic obstruction will yield to electric treatment. That some do is indisputable. Since this agent can do no harm, and since little time is consumed in its application, and in some cases its results are curative, it should be given a fair trial in suitable cases.

**Gaseous Injections.**—The injection of air or gas as a means of locating and of overcoming intestinal obstruction has lately been warmly and nearly universally commended. The indications for the use of air-insufflation are practically the same as for the employment of aqueous injections. It cannot, of course, be denied that gas diffuses more readily than water, and hence that it may pass an obstruction that would effectually bar the ingress of the latter. The pressure, however, is not so readily regulated, and, as in certain cases the weight of the water seems to be an important factor in the accomplishment of the cure, insufflation is not so valuable a method of treatment as injection of liquids. The cause of frequent failure in the use of insufflation, as in the employment of liquids, is dependent upon an imperfect method of applying this treatment. Any injection into the bowel causes a spasmodic resistance and effort at extrusion. This is increased if the pressure is constantly varying. Spasm ultimately yields to steady, continued pressure, even though this be slight. If obstruction is to be overcome, the gas must reach the seat of trouble, and it is far safer to accomplish this by moderate continued pressure, continued for fifteen, than by rapidly increasing the pressure if in five minutes no results seem to follow.

Reported cases of rupture which have occurred during insufflation show that this method of treatment is not without danger. A manometer should always be attached to the injection-pipe for the purpose of accurately gauging the amount of pressure employed.

**Metallic Mercury.**—The use of metallic mercury as a means of overcoming obstruction is rare at the present day. Yet this treatment is warmly advocated by Matignon, who states that when employed in cases of ileus following faecal accumulation the metal becomes finely divided, and so coats and penetrates the obstructing mass that the latter is loosened and its discharge is facilitated. Matignon states that in no instance is mercurial poisoning produced; that pain and vomiting are quickly relieved; and that frequently, after all other means have proved absolutely fruitless, a prompt evacuation of the bowel contents follows



this treatment. Mercury has also been employed as a rectal injection, in the hope that by its weight invagination might be reduced. Heard injected one pound into the rectum of an infant aged five months, and then inverted the child, hoping by this means to cure an intussusception.

The special applicability of mercury would seem to be in cases of fecal impaction where other means of treatment have not been successful.

**The Rectal Tube.**—In the beginning of paralytic distension the rectal tube is of distinct value. It excites peristalsis, and by overcoming the resistance of the sphincters relieves tension by allowing large quantities of gas to escape. The sharp angularities of the sigmoid flexure and its free mesenteric attachment prevent the point of the tube from passing beyond this portion of the gut; hence there is nothing gained by passing the tube deeper than ten inches. The attempt to reduce an invagination or volvulus by a stiff tube is not to be commended.

**Injections of Ether.**—Ether has sometimes been injected into the bowel as a means of encouraging peristalsis, and in cases of invagination as a means of dilating the lower bowel by its vaporization and thus effecting reduction. Clause reports two successful cases in which relief was immediate upon the injection of a pint of a 3 per cent. solution of ether. This treatment is, however, followed by a local inflammation so violent that it at times excites a pathological condition as dangerous as that for the cure of which it is advised.

**Position.**—In medical literature there are a number of cases recorded in which marked symptoms of obstruction were immediately overcome by either inversion of the patient or inversion combined with shaking. The knee-elbow position persisted in for some time has at times relieved symptoms.

**Abdominal Massage.**—Hutchinson highly commends kneading of the abdomen under an anæsthetic and in combination with injections as a treatment for nearly all forms of intestinal obstruction.

In the obscurity which always surrounds cases of obstruction the judicious application of massage is purely a matter of chance. Not only may it be hurtful in cases of peritonitis, but it may immediately determine the rupture of a greatly distended and congested loop of gut. It is easy to see how massage may be beneficial in every form of acute obstruction, but to apply this method so that it will necessarily produce the result desired is an impossibility.

When intussusception is seen early, the effect of injections may be materially aided by massage, and in cases of fecal impaction uncomplicated by peritonitis this method of treatment has given good results.

The application of ice to the abdomen and the administration of

lead bullets by the mouth, both treatments which have been warmly advocated, are mentioned only to be condemned.

**Puncture of the Abdomen.**—In cases of meteorism sufficiently developed to embarrass the respiratory function, Ogle advocates one or more punctures into the distended gut by means of an aspirator or hypodermic needle, and the withdrawal of as much gas as possible. These punctures should be made in the most distended part of the abdomen. After all the gas that can be drawn out is evacuated, a few drops of carbolic solution or iodoform oil should be injected through the needle to disinfect the punctured tract.

In excessive and dangerous tympany punctures may be of service. They should be made by means of a fine needle and under most careful antiseptic precautions. The needle should be driven in with a sudden violent thrust, the thumb guarding against too deep penetration. This lessens the danger of the bowel being pushed before the point of the instrument, rather than being penetrated by it. A wire should be provided for cleaning the canal of the needle in case this becomes blocked. If the gut is in a condition of absolute and hopeless paralysis, feces may leak through even the minute opening made by a hypodermic needle. Because of its blindness and inadequacy this method of treatment is very generally condemned.

**Enterostomy and Colostomy.**—By these terms is meant the establishment of an artificial anus in the small and in the large intestine respectively. The operation, when it concerns the small intestine, consists in making an incision in the right iliac region and securing the first distended intestinal coil which presents to the entire circumference of the peritoneum about the parietal wound, the peritoneal and skin surfaces of which have been united by a continuous suture. The gut is then incised and its contents evacuated. This operation is one which may be indicated when the surgeon is not called to see a case of obstruction until the patient's general condition is so bad that formal operation is contraindicated. In these cases it has often succeeded in saving life. The relief afforded by the artificial opening frequently allows Nature to overcome the obstructions in the intestinal canal. If this occurs, the fecal fistula will close spontaneously or may be closed by plastic operation.

Colostomy, or an artificial anus opening into the colon, will be indicated in inoperable cases of acute obstruction located in the colon. It is rarely performed except for the relief of chronic obstruction, such as that which occurs in cases of cancer of the rectum. For convenience to the patient an inguinal operation is to be preferred.

**Abdominal Section.**—By this term is implied a formal opening of the abdominal cavity for the purpose of discovering the seat and



nature of the obstruction, and of restoring the continuity of the alimentary canal. Where gangrene or other local condition necessitates resection of the gut, end-to-end suture or approximation by the Murphy button is indicated.

In all cases of acute obstruction abdominal section should be immediately resorted to after one thorough attempt at restoring the continuity of the intestinal tract. The low mortality from this operation as gathered from statistics is most encouraging. During and after operation heat preservation and combating of shock are most important indications. The operation should be performed as quickly as possible. Provided, however, the temperature of the operating-room be kept high, the intestines be protected against the chilling and irritating effect of direct evaporation, bleeding be prevented and the anæsthetic be given judiciously, there is little need for hurry. At the completion of the operation shock will be relieved and a natural position of the intestines will be favored by copious flushing out of the peritoneal cavity by 0.7 per cent. sterile saline solution at a temperature of 106° F. Clarke's suggestions to leave a litre of salt solution in the abdominal cavity and to elevate the foot of the patient's bed subsequent to operation should be followed when the intra-abdominal manipulations have been extensive and prolonged.

The whole treatment of acute intestinal obstruction may be briefly summarized by stating that in invagination and in intestinal paralysis only should operation be delayed. In invagination the delay should not be longer than the time required to note the effect of one deep-forced injection. This is a matter of a few hours at most. Internal paralysis should be treated in accordance with its cause. In general, the knife and hot saline flushing should be held as the last resort.

In obstruction due to strangulation, volvulus, congenital malformation, or foreign body the first thought should be operation, nor should any other method of treatment be considered to the exclusion of this.



## DISEASES OF THE RECTUM AND ANUS.

By JOSEPH M. MATHEWS, M.D., LL.D.

It is the purpose of the writer to try and deal with the subject of Diseases of the Rectum and Anus in a practical way. In the last decade much has been written concerning the treatment of these diseases, and it cannot be gainsaid that the necessity exists. Surgeons of much repute have been giving special study to the subject, and no work on surgery or medicine is now considered complete that does not give consideration to this most important class of diseases. Recognizing the fact that from time immemorial, patients suffering from rectal disease had but little offered them in the way of relief, save by the itinerant quack or charlatan, it is but meet and proper that the physician of to-day should be well posted in their treatment, especially in a palliative way. The time has passed when a *placebo*, such as ointments, powders, etc., can be presented satisfactorily to the patient suffering from any one of those numerous complaints which commonly affect the rectum and anus. He will either at once recognize the gross ignorance of the physician so doing, or after a trial hasten to some one in whom he has more confidence. No part of the anatomy has been so outrageously imposed upon by the pretender as have the rectum and anus. In times past the regular physician has seemed to intentionally neglect this class of patients, and therefore it is no wonder that they have fallen into the hands of the illiterate and pretentious quack.

**Examination.**—Disease in the rectum is oftentimes made manifest by decided symptoms that cannot be mistaken; at other times the manifestation may be so obscured or the disease so insidious as to make a diagnosis very difficult. To achieve success in the treatment of rectal diseases one must be able to differentiate between a score of affections which by the medium of reflex action simulate a diseased condition of the rectum. To jump at conclusions without a plausible process of reasoning would only result in grave error. It seems to be nearly universal for patients suffering from any diseased condition of the rectum to designate the same as "piles." Hence the physician often makes the mistake of prescribing for a disorder that the patient has diagnosticated, and that he is not really affected with. Therefore



it cannot be urged too strongly that in every case an examination of the parts should be made.

Much paraphernalia is not necessary in order to make a thorough examination of the rectum; indeed, in the majority of instances a speculum will be found superfluous. Before placing the patient upon the table for ocular inspection, etc., it will be found advantageous to ask some questions or to have him describe his symptoms. The following might be suggested: The age of the patient. How long affected. The amount of pain; character of pain; whether it is connected with act of defæcation or not. What the character of fæces: whether moulded or not; whether bowels are constipated or loose. State if blood, mucus, or pus is found in stools: if blood, whether light or dark. Whether bowel protrudes at stool: if so, does it replace itself, or does patient put it back? What is the condition of the kidneys? do they act too often or not often enough? State the amount of urine passed in twenty-four hours. Has the patient ever had syphilis? Is there a tubercular tendency in family? Has the patient ever had gonorrhœa? Has he ever been told that he had stricture of the urethra? If the patient is a female, ask whether married or single; if she has ever borne children; if any rupture of perineum, etc., took place; if any ovarian or uterine pain exists; if any discharge from the vagina, prolapse of womb, or difficulty of urinating. Ask concerning any special diathesis, such as rheumatic, neuralgic, etc. Note loss of flesh, especially so if rapid.

Any one or all of these questions may prove of service in properly diagnosing a case. It must not be presumed, because a patient complains of rectal trouble, that in all cases the seat of disease is in the rectum. Very often the rectal symptom is but a cry from the real seat of disease through the medium of a nerve. The writer has had under treatment five cases where the patients came to him to be treated for rectal disease when in truth none existed, and the symptoms were traced to a displaced kidney. It is well known that a stricture in the urethra will often give the most pronounced pain, irritation, etc. in the rectum. An enlarged prostate is one of the most frequent causes of irritability, etc. in the rectal walls. A displaced womb may often set up symptoms which point to this part of the anatomy. It may be incumbent then to make a general examination of all contiguous organs before stating positively that the rectum is accountable for the symptoms presenting. In this connection it might be well to call attention to the fact that the coccyx is sometimes responsible for great disturbances in the rectum. It is well, therefore, to examine this little bone, and to inquire after any trauma that may have happened to it; and also not to forget that it may be the seat of disease outside of the trauma. A constitutional diathesis should

never be forgotten in making up the verdict of disease in the rectum or elsewhere. Whether a physician is prepared or not to operate in these diseases, his general knowledge should be such as to enable him to ferret out the real cause and seat of the disease. Presuming, then, that all proper questions have been asked, an examination should now be made; in other words, the physician should not take the patient's diagnosis, and prescribe without making an ocular inspection of the parts before prescribing. A flat, hard table, a rectal speculum, a pair of dressing forceps, are all that is needed for this examination.

Placing the patient on the table, in Sims' position (on left side), with a good natural light, first inspect the buttocks, anus, perineum, thighs, and scrotum for any abnormal condition. Much evidence may be obtained by this inspection. For instance, the following may be detected: External piles, fissures, condylomata, eczemas, external opening of fistulæ, discharges from the rectum, external growths, syphilitic erosions, gonorrhœa in women, etc. Next, anoint the fore finger and gradually introduce it into the anus. The following should be noted while this is being done, viz.: The condition of the sphincter muscle, whether close and rigid or loose and patulous; whether hypertrophied or thinned; whether resisting or non-resisting. With the finger in the rectum the following conditions can be diagnosticated: First of all, note the prostate gland if the patient is a male—whether enlarged, sensitive, indurated, or softened. In the female, the position of the womb—whether or not any displacement that may be responsible for any of the rectal symptoms. In obscure cases the examination of the uterus and its appendages should be made. In the virgin it is well to inquire after the menstrual flux—whether regular or irregular, painful, profuse or deficient in quantity. The bladder should not be neglected in searching for a cause of rectal disturbance: vesical irritation is a frequent factor in these cases. Stone in the bladder may often be found when least suspected, and prove a great source of reflex irritation to the rectum.

After making a thorough investigation of contiguous parts, the rectum can be further explored with the finger, the best of all methods, and the following conditions may be detected: Polypi, openings of internal fistulæ, strictures, ulcerations, cancer, internal piles (when *indurated*), abscess, foreign bodies, etc. Ordinary internal hæmorrhoids that have not undergone atrophic change or the inflammatory process cannot be detected with the finger.

THE SPECULUM.—In the vast majority of rectal cases it is not necessary to make an examination with the speculum; it is generally a painful procedure and reveals but little. The person who is *au fait* in making such examinations can more readily make a diagnosis with the finger than by any other means. The speculum should only be

used after the finger has failed to detect the trouble or the clinical facts in the case demand its use—such as obscure hæmorrhage, pain, or a discharge of pus, mucus, or a combination of the two. Perhaps the openings of internal fistulæ can be diagnosticated by sight through a speculum, especially if the discharge can be seen. Internal hæmorrhoids will fall between the blades of the speculum, of course, but a much better impression can be gained by having them protruded by the patient.

**THE PROBE.**—The probe is of but little utility in any rectal disease except perhaps fistula in ano, and is overestimated in this affection. It can just as well be told that fistula exists, if a sinus can be *felt*, or an opening *seen*, as to explore with a probe. It makes very little difference under which head—internal, external, or complete—the fistula may be designated, as each must receive the same treatment.

**SOUNDS.**—Many varieties of sounds are used for the purpose of diagnosing rectal affections, especially when the disease is located high up the rectum. The advantages of such are purely chimerical, and the disadvantages very apparent. *Imaginary* strictures are often found, because of the catching of the sound in the folds of the gut, or perhaps by meeting with a natural obstruction, such as the promontory of the sacrum, the uterus in the female, or an enlarged prostate in the male. Besides, a sound may prove to be the source of great danger. If of metal or hard rubber it may be pushed into the peritoneal cavity, especially if a pathological condition exists, as cancer, ulceration, etc. If any instrument of the kind is to be used it is much better that a soft-rubber one, such as Wale's rectal bougie, be kept on hand for this purpose. It is twelve or fourteen inches long, and by injecting water through it the whole length of the rectum can be explored without danger.

To sum up, it can be truly said that 80 per cent. of rectal disorders can be diagnosticated by the use of the finger, and the remaining 20 per cent. by taking the clinical history of the case, and by the use of the speculum, and that it is seldom necessary to use either probe or sound.

**Preparation of Patient for Operation.**—The modern surgeon realizes that the terms minor and major surgical operations are ill defined. The chief risk in all wounds is from sepsis, and the micro-organism can enter through a small wound as well as through a large one. Many of the operations around the rectum might under said classification be called minor, when in truth, if every safeguard is not thrown around the patient, infection may speedily take place and the termination be a fatal one. The writer recalls one death from tetanus, following the ligation of hæmorrhoids. Therefore all operations



around the rectum should be done under strict antiseptic precautions. The rectum, as is well known, is abundantly supplied with lymphatics, and its blood-supply is enormous. The pathogenic germ finds here a ready entrance into the system. At best, this portion of the gut is difficult of perfect asepsis; hence the greater should be the effort of the surgeon. Whatever may be the differences among surgeons as to the necessity of employing agents to produce an antiseptic condition (chemicals) or simply procuring an aseptic field, certain it is that the antiseptic method is to be preferred in rectal work.

In preparing a patient for an operation in this line there are a number of things to be looked after: First, the habits of the patient should be known. For instance, in operating for hæmorrhoids in the drinking man it is of much importance to look after the liver for several days before operating. The portal circulation in such a patient is greatly interfered with. It is well to order in a case like this a good dose of calomel for two or three consecutive days, and then a thorough passage with a saline. It should be understood that perfect abstinence from drink should be observed for a number of days before the operation. Before operating for any rectal disease (especially an obscure one), affections of contiguous organs should be carefully noted, else a confused prognosis will likely be made.

Having determined that the case is a suitable one for operation, the following plan will be found a serviceable one: A free purge should be given the day before the operation. The next morning the rectum should be washed out with a large enema of hot carbolized water; the patient is then given a bath, the parts are shaved, and he is ready for the surgeon. When under the effect of the anæsthetic the whole field of operation should be scrubbed with soap, and then washed with a bichloride solution. The sphincter muscle is now divulsed and the rectum thoroughly irrigated with bichloride solution 1:5000. Then the operation is proceeded with.

It seems to be the impression with some that whatever may be the necessity for strict antiseptic measures in surgical work, the rectum is to be neglected in this particular. It is very true that because of its peculiar office it is difficult to procure a perfectly aseptic condition of the parts; but it would be a grave mistake to neglect every effort to accomplish this result. As has been stated, the rectum is the seat of an abundant blood-supply and lymphatic distribution which readily invites sepsis. Every rule laid down for antiseptic surgery should be carefully followed when doing these operations. Quite a number of cases of tetanus are reported as following rectal operations, and it can be readily understood that general sepsis could obtain. After a complete bath of the body the local field should be scrubbed with soap and water, and irrigated with the bichloride solution. Then with a

good speculum the sphincter muscle should be widely dilated and the irrigating process extended to the rectum for a number of minutes. All wounds that are made in doing the operation should be dressed with iodoform or bichloride gauze, and the instruments of course sterilized before the operation. Dressings should not be allowed to remain on long enough to become septic, but removed as early as the exigencies of the case demand. It is true that the dry dressing plan is to be preferred in all surgery around the rectum, but the interval between the changing of dressings must be in accordance with antiseptic rules. With each change thorough irrigation of the parts must be practised. The surgeon neglecting such precautions must expect to have the same bad results as would obtain in doing any other surgical operation. It is not the purpose of the writer to name any special agents to accomplish good results, but simply to advise that antiseptic precautions be taken in every case.

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### HÆMORRHOIDS.

It is a singular fact that a majority of patients suffering from rectal or anal trouble will designate it as "piles." It is more singular that many physicians will take the diagnosis of the patient and prescribe some local application, without once making an examination of the parts. The same physician would not think of taking the patient's opinion concerning disease in other portions of the body, therefore why trust to his diagnostic power when the malady attacks the rectum? Patients often imagine that a very slight trouble in this part of his body is of the gravest sort, and it is often a difficult matter to satisfy his mind that a fissure of the anus, or the presence of a small hemorrhoid, is not a cancer of the rectum. *Per contra*, very formidable disease here is treated by the patient as a very simple affair. It is, then, a matter of great importance to examine each case—by ocular inspection at least, and generally by the aid of instruments. It is a question with some as to which one of the rectal affections predominates. If the patient's opinion is to be taken into consideration the question could be quickly settled in favor of "piles," for this is nearly the unanimous verdict. If the doctor who prescribes indiscriminately for these affections the same local remedy, the same verdict could be had.

In speaking of this subject, Mr. Allingham in his most excellent work says: "Fistula is, at all events in hospital practice, the most common rectal disease affecting the adult. Out of 4000 cases taken consecutively and without selection, at St. Mark's Hospital, from the



out-patient department, there were 1057 persons suffering from fistula, and 196 from abscess, of which 151 subsequently became fistulæ, so that more than one-fourth of the cases treated were fistula." This has not been the experience of the writer, but instead, hæmorrhoids has predominated in his practice as a rectal affection. In making this statement it is intended to include all varieties of hæmorrhoids, both external and internal. It has been argued by some writers that climate plays a part in the production of the hæmorrhoidal condition, and that habits incident to certain nations as well as individuals do also. As to the former statement, it might seem plausible that in the hot climate this affection would be oftenest found, but the experience of the writer does not bear out the assertion. As to national habits, especially the drinking one, it might be asserted that England cannot boast of any special abstinence over the States. Again, it must be remembered that fistula may be only a complication of some other trouble, and not only secondary but caused by it. It is a familiar fact that stricture of the rectum often is the originating cause of fistula, and in making up statistics of such a case it should be put down as a case of stricture, and not of fistula. Therefore, after an observation of several thousands of both affections, the writer is constrained to believe that hæmorrhoids predominates as a rectal affection, at least in United States.

For convenience of description as well as treatment, a division will be made between external and internal hæmorrhoids. It is sufficient for the patient to know that he has a case of piles, but the physician must draw the distinction between them in order to give the case rational treatment. Indeed the same methods will not obtain in both. To illustrate: a patient suffering from an enlarged and inflamed external pile is always making a strenuous effort to push it into the rectum, when its place is outside the sphincter muscle, and any handling for the purpose of "reducing" it adds to the patient's discomfort.

#### EXTERNAL HÆMORRHOIDS.

External hæmorrhoids are generally described under two varieties, viz. *venous* and *cutaneous*. The term *thrombotic* would be more appropriate in describing the first variety, for it is really a *blood-clot*. It has been discussed by some writers whether the clot coagulates in the vein proper or in the tissues. This matters very little as far as the treatment goes. The seat of both varieties is at the verge of the anus, and they cause about the same amount of disturbance. Some have applied the term "blind piles" to the external variety in contradistinction to the "bleeding" variety of internal piles. To say the least of the term, it is unsurgical and signifies nothing. The symptom of bleeding is always of much significance to the patient, and the one



that first causes him to seek advice from the physician. Whenever bleeding occurs it is safe to affirm that it is from an internal pile. External piles do not bleed, although there is a "mixed" variety which is partly external and partly internal, found just at the verge of the anus, from which blood will escape from the internal portion. This small tumor is covered by true skin externally, but has mucous membrane lining the upper portion. By taking hold of the lower part of the tumor and drawing it downward and outward the inner portion will be exposed.

**SYMPTOMS.**—The symptoms of external piles generally come on suddenly, the patient likely feeling no discomfort in the morning, but before night being aware of decided trouble. Pain is the most prominent symptom, and the patient seeking for a cause finds this tumor at the verge of the anus. Not knowing of the varieties of piles, and imagining that this tumor belongs inside the rectum, he immediately begins an effort to push it inside, thereby adding to his distress. The pain arising from the venous or thrombotic pile is caused by tension; that from the enlarged tag of skin, from the inflammatory process. Itching often accompanies an attack of external piles, and proves to be distressing. If the patient does not quit work, his condition grows worse because of the exercise and irritation of the parts. His habits, too, have much to do with the aggravation of his symptoms.

**CAUSES.**—It is often a difficult matter to trace the cause of an attack of external piles. Many persons have a superfluous amount of skin, or tags of skin, around the anus. This condition, of course, could be easily excited to the inflammatory process by irritation, filth, etc. It would also be set up by a teasing diarrhœa or dysentery. The use of rough or printed paper, or other coarse articles as detergents could excite to the same condition. The thrombotic pile is oftenest caused by straining at stool, as for instance in the constipated habit, though many persons who have this habit never suffer from piles. It can be understood, too, that a diarrhœa or dysentery could produce that straining effort which would rupture a vessel. Many persons, however, will report for treatment for external piles who have no such diseases and are of perfectly cleanly habit. It is believed by some that such habits as drinking or smoking act as a factor in producing external piles. Such habits are much more likely to produce internal piles. Certain it is that any local irritation of the parts from whatever cause will aid in producing an attack. Among these agents may well be mentioned the bicycle. The continued sitting upon the saddle incident to a long ride is a common cause of the trouble. The writer has operated upon one patient three times for external piles caused by riding the "wheel." Some authors

believe that pressure by a displaced uterus upon the rectum may cause external piles. An enlarged prostate or a stricture in the urethra may act as exciting causes to this affection.

#### TREATMENT.

The treatment of external piles should be to a great extent prophylactic. Even children should be taught the necessity of a daily evacuation of the bowels. Patients generally should be instructed to avoid the straining effort at stool, and the importance of leaving the seat as soon as the bowels are through acting. Very many persons, especially in the country, are in the habit of using common printed paper as a detergent. This should be strongly condemned. The mucous membrane everts when the bowels act, and nothing is more irritating to it than ink; indeed, it would be well to discard all paper from the water-closet and use instead cold water for the purpose of cleanliness. No paper can thoroughly cleanse the anus after the act of defæcation, but the water will. Besides, the source of irritation is gotten rid of. If, however, a patient presents himself with a case of external piles he should be properly cared for. There is more pain and discomfort attending an attack of the external variety than from an ordinary attack or the presence of internal piles.

An examination should be made of the parts to determine which variety of piles is to be dealt with. The rectum should also be investigated in order to find out if some other pathological condition does not exist which of itself may be the cause of the attack of piles. If it is an uncomplicated case, palliative measures alone may allay the attack. By "attack" is understood the inflammatory condition which is manifest in the tag of skin or the presence of a blood-clot in the tissues.

The bowels should be cleared with an aperient, such as a dose of salts, castor oil, or citrate of magnesium. No active exercise should be indulged in, and really it would be better for the patient to assume the recumbent position, but it is not often the case that you can induce him to do so "for so trivial a cause." Heavy eating, such as much meat and bread, and the use of wines or other liquors should be interdicted. The bowels should have a liquid movement each day, and after each stool cold water should be freely applied. In some few cases the use of hot water seems more soothing to the patient and should be preferred. It is seldom necessary to poultice the parts. The inflammatory process will subside under this plan of treatment in about one week or ten days. Ointments do but little good save to allay itching; the best for this purpose will be found one containing menthol, such as—





those found external to the sphincter muscle, and the internal piles being those originating inside of the sphincter. It makes very little difference as far as the treatment is concerned whether a pile is of the venous or arterial sort. It is well to draw a distinction between bleeding and non-bleeding piles: those that do not bleed are not at all dangerous; and, again, hæmorrhage is of all symptoms the most important to the patient.

*Capillary Hæmorrhoids.*—The capillary pile is the most insignificant of all as far as size is concerned, but is the most dangerous of the three varieties. Excessive hæmorrhage may take place from this variety of hæmorrhoid. It is not infrequent that large quantities of blood are lost in this manner, and a few deaths have been reported from hæmorrhage arising from a capillary pile. Of course, in such a case an arterial branch is concerned, and from this a fatal hæmorrhage might occur. The writer has had a number of cases of violent hæmorrhage from internal piles, but in every instance it was from a small and not from a large tumor. This variety of hæmorrhoid is not larger than the end of the little finger, sometimes much less, and resembles a raspberry in appearance. In the main they are made up of capillary vessels, but some vessels that feed the growth are of good size. When subjected to ocular inspection they are granular in appearance, but as time advances the friction to which their surfaces are subjected does away with this rough or granular condition, and the mucous membrane extends over them. Therefore it is in the incipient stage especially that they are dangerous through hæmorrhage. Later on the areolar tissue becomes thickened, and by plastic deposit the disposition to bleed is checked.

*Venous, Internal Hæmorrhoids.*—The venous pile is supposed to be the largest in size. Oftentimes, especially in the feeble, relaxed subject, they get to be as large as a small orange. They prolapse easily at stool and are sometimes difficult to replace. They do not bleed unless ulcerated, and generally the only symptom complained of is inconvenience in "putting them back," or the patient complains of soiled linen from their presence. It is a mistake to suppose that the entire blood-supply in this variety is venous, as the name would imply, for they may also receive arterial distribution. However, the hæmorrhage from this variety of pile is generally venous and is not followed by any serious consequences, especially in the healthy subject. In some this bleeding is said to be advantageous.

*Arterial Hæmorrhoids.*—Strictly speaking the term "arterial hæmorrhoid" is a misnomer. No hæmorrhoid is exclusively made up of one set of vessels. The arterial blood-supply may predominate, as it undoubtedly does in the arterial variety of piles, but there is also a venous circulation, and it is in this class that great danger exists in

the injection with carbolic acid or any other agent capable of coagulating the blood. The arterial pile is made up of dilated blood-vessels, and connective tissue abounds in them. For this reason it is out of the question to suppose that they can be cured or eradicated by the "squeezing" process, as proposed by Manly and a few others.

#### SYMPTOMS AND DIAGNOSIS.

It is quite an easy matter to diagnosticate *internal* piles, as such, but it would be a difficult matter often to say whether a tumor was of the arterial or venous variety. In the first place neither variety has hæmorrhage for a symptom, and should blood escape no differentiating between the two could be done, inasmuch as either venous or arterial blood could issue from either class. It is much easier to diagnosticate a capillary pile than to draw a distinction between the arterial and venous kind. Hæmorrhage is the chief symptom complained of, and all symptoms of the two other varieties are absent. For instance, a patient states that while at stool a copious hæmorrhage took place, which was perhaps repeated each succeeding day; that the blood was of bright color, and came in spurts; that no protrusion of the bowel occurred, that a feeling of dizziness succeeded the loss of blood; that pallor of countenance followed; and that pain was not a factor in the case.

It will be observed that all of the prominent symptoms of the large variety of piles are absent, viz. protrusion, which requires the replacing of the tumors; pain, which is often caused by friction; and the other symptoms which have been mentioned as characteristic of the arterial and venous variety. When such symptoms are present, an examination of the rectum should be made with the speculum. The tumor may be so small, soft, and velvety as to elude detection by the finger, and it should also be remembered that this form of pile may be located at a little distance up the bowel, at least higher up than either of the other two varieties. With a good light, and a speculum that will dilate the sphincter muscle well, this little tumor can be easily found. Generally the force used to open the bowel will open up afresh the bleeding vessel, and the blood can be seen to spurt or bubble up at the site of the tumor.

To diagnosticate the other two varieties of internal hæmorrhoids an entirely different method should be practised. When hæmorrhage is a prominent symptom, and occurs in any great quantity, it can be safely said that it is not from either the arterial or venous variety, certainly not from a large or well-formed tumor, for in such we find cell-growth and abundant connective tissue, the result of plastic infiltration. This checks the avenues of hæmorrhage, and it could only occur as the result of trauma or some force equal to the break-



ing of an artery. That this sometimes occurs cannot be disputed, but is not the rule. The capillary pile is a soft, spongy, or granular mass, which yields easily to slight force, hence bleeding is the rule. It can be said, then, that great danger can lurk behind capillary piles—in hæmorrhage—and that from the large, well-formed pile there is but little danger to be apprehended. When it is suspected that internal piles exist other than the capillary kind, it should be asked whether protrusion of the mass takes place at stool. If no such history is given it can be safely said that if hæmorrhoids exist, they are not of much size. It must be remembered in this connection that the patient's diagnosis or opinion must not be taken, as he will invariably call any disturbance around these parts hæmorrhoids.

Although the fore finger is the best agent that we can employ for examination of the rectum, it absolutely fails as an aid to making a diagnosis of internal piles. Even pile-tumors of good size cannot be detected with the finger after they are returned within the rectum. There is but one exception to this, and that is when the tumors have undergone the atrophic condition, are sessile, or pedunculated. The reliable way is to have the patient retire to the water-closet and "strain" the mass out, so as to be *seen*. If he should fail in this, dilate the sphincter with the speculum, and the tumors will be seen to fall between the blades.

The symptoms of internal piles are not well marked and certainly are not characteristic of the disease. Pain in the thighs, back, and loins; a frequent desire to pass water; general lassitude, etc. may be complained of, but these symptoms may exist from many other causes. It is better to look after the symptoms referred by the patient directly to the anus or rectum, and by an examination determine if there is any pathological change.

It is very common to ascribe constipation as a cause, or more properly speaking the chief cause, of internal piles. This belief cannot be borne out by fact. It can safely be said that the majority of people who suffer from piles are not of the constipated habit. It may exist, and of course sometimes does, but it is rather a coincidence than a cause of piles. That there is a hereditary predisposition to the hæmorrhoidal condition is pretty certain. It will often be found that whole families are given to the trouble. Patients often cite the fact that their parents, if not their grandparents, were the subjects of piles. Of course it must not be overlooked that the child-bearing woman is often the subject of internal hæmorrhoids. In these cases the tumors will be found just at the verge of the anus, and oftentimes in a prolapsed state. Children very seldom are afflicted with internal piles, though some such cases have been reported. In extreme old age piles are not often found, although they may have



existed in former life—they undergo atrophic change and, in common parlance, “dry up.”

Uncomplicated internal hæmorrhoids cause very little disturbance, but when the seat of inflammation or ulceration cause great pain and distress. Such an outbreak is designated by the patient an “attack” of piles. This term can be used in regard to both external and internal piles. The tumors may remain quiescent for a long period of time, and seemingly without cause will become inflamed, and many distressing symptoms result. Patients will often use an expression like this, “I have often had piles before, but I was cured by some simple remedy, and have not had them for a long time”—when in truth he has had them ever since the first attack, but when the inflammatory symptoms subsided he considered himself cured. Although generally the patient cannot trace the cause of his “attack,” it may sometimes be found as the result of a diarrhœa, flux, exposure to cold, bicycle or horseback riding, excessive venery, rough handling of the parts, the want of cleanliness, the use of alcoholic stimulants, and sometimes excessive smoking.

There is a “mixed” variety of pile which is not discussed by the authors, save by the author in his book on *Diseases of the Rectum*. It consists of both true skin and mucous membrane. The external part appears as a long tag of skin, and when pulled on a portion of the mucous membrane is everted, which is much thickened and highly congested. In operating for this variety of pile it is necessary to ligate after making the incision around the base, as in the event this was not done violent hæmorrhage could ensue.

In making the diagnosis of internal hæmorrhoids, all contiguous organs should be examined, in order to determine whether they play a part in the production of the rectal disease. An enlarged prostate, or a stricture of the urethra, may cause excessive straining, which would aid in the production of piles; a displaced womb or an irritated ovary might be a factor; stone in the bladder, a diseased kidney, hernia, varicocele, etc. might exist and result in decided reflexes, and aid in producing an attack of piles or other rectal symptoms. A proctitis which antedates the hæmorrhoids may be the cause of the inflammatory attack, or a colitis of long standing may be the exciting cause. In looking to a cure of internal piles, especially by palliative measures, every one of the above-named conditions must be sought for and eliminated, or corrected. The physician who expects to be successful in the cure of disease in any local portion of the body must be familiar with disease in a general way, or he will be making all manner of mistakes. It is the painstaking diagnostician that is the successful practitioner of medicine.

## PALLIATIVE TREATMENT OF INTERNAL HÆMORRHOIDS.

The same thing that was said in regard to the treatment of external piles will obtain in the treatment of internal piles, viz. it must be highly prophylactic. The habits must be looked after, the secretions corrected, and symptoms which have a tendency to produce the hæmorrhoidal state should be treated. It is well recognized that the free use of spices and condiments—mustard, pepper, pepper-sauce—such things as the epicure is fond of, is productive of hæmorrhoids and other forms of rectal trouble. If, then, a patient is concerned about the hæmorrhoidal condition, or indeed other rectal trouble, it would be well for the physician to interdict the use of all such articles. There can be no question that the person who uses alcoholic or malt liquors to excess is more liable to hæmorrhoids than those who abstain from such drinks. The portal circulation is interfered with by such habits, and as long as they are indulged in but little could be done by the physician to effect a cure; or, granting that the patient is willing to abstain, it is well before beginning any special treatment for hæmorrhoids to look after the liver. Certainly before operating upon a patient given to the drinking habit, mercurials should be given for a number of days in succession, followed, of course, by aperients or laxatives. This class of patients are also given to over-eating. The appetite is really a morbid one stimulated by drink, and the overcrowding of the stomach is productive of grave results. The diet of the patient should therefore be looked after.

The class of patients who suffer from hæmorrhoids will sometimes be found of the constipated habit. If so, it will prove to be a most formidable complication and difficult to overcome. Such people should be advised to become water-drinkers—drinking as much as half a gallon per day, at intervals. For such, fruit should be freely prescribed—oranges, apples, figs, prunes, etc. Quite a good suggestion is to have the patient take prune-juice once a day, prepared in the following manner: Make a small bag of linen or cotton cloth, and put into it a handful of senna leaves. Place the bag with the prunes and boil for a sufficient length of time. When done strain the juice, and drink a small quantity once or twice a day. It will have a nice effect over the constipated habit.

Very often these patients will be of a morose or melancholy disposition and take very little exercise. Nothing is more conducive to good health than exercise; and, of all methods, walking is the best. The patient should be advised to take regular walks, especially in the early morning and late in the evening.

But we are to suppose that the patient presenting is suffering from an actual condition of hæmorrhoids: what advice or treatment is to

be afforded? Under such circumstances it of course must be determined what character of hæmorrhoids the patient is suffering from. If hæmorrhage is the symptom, and no history of protrusion is given, it would of course be presumed to be a case of capillary piles. These are seldom accompanied by pain, and it is the sight of blood that has driven the patient to consult the physician; or it may be the drain upon the system occasioned by the frequent hæmorrhages. This condition will often be witnessed in the female, who, from the loss of blood by menstruation together with the same from piles, suffers to such an extent as to produce profound anæmia. The main thing in such a case is to stop the hæmorrhage. To do so will be found a more difficult matter than is generally supposed. Ordinary astringents, those that are usually prescribed in such cases, have but little action for good. Reference is made to alum, tannin, borax, and others of this class. Besides, such procrastination might end in serious results. If the bleeding is pronounced, it is best to resort to something more effectual at once. The following plan may accomplish the purpose: With a speculum divulse the rectum freely, irrigate with hot water, watch for the bleeding-spot, and touch it with a drop of pure nitric acid from the point of a glass rod. Carbolic acid is commended by some for the same purpose, but is less effectual than nitric acid. The point of the actual cautery (Paquelin) will subserve the same purpose and is often to be preferred to both. If it is deemed inexpedient to use either of the above plans, recourse must be had to the prescriptions. The following are those commonly used:

R. Tannin,	ʒj (4.0);
Cocaine,	gr. iij (0.15);
Cocoa butter,	q. s.

M. et ft. suppositoria xij.

Sig. Insert one morning and night.

Or,

R. Ferri subsulphatis,	gr. xij (0.8);
Cocaine,	gr. viij (0.5);
Vaseline,	ʒj (30.0).—M.

Sig. Apply to the protruded parts.

Or the ferri subsulphatis can be used in a suppository, and it will be found to be of much greater efficacy than tannin.

If the hæmorrhage should not yield to the ordinary means, the following plan will be found to be a most excellent one in arresting hæmorrhage from internal piles, especially of the capillary variety: Have the rectum well washed out with hot water; dilate with a speculum, and place in the rectum over the bleeding surface of the piles



a small pad of gauze which has been freely moistened with Monsell's solution diluted with an equal part of water; withdraw the speculum and allow the pad to remain in for forty-eight hours. In the vast majority of instances it will be found that this procedure will effectually stop all bleeding. Mr. Allingham recommends the injection into the bowel of hamamelis twice a day in these cases.

When the "palliative treatment" of piles is spoken of, reference is made to the incipient stage of the disease, for after a well-defined pathological change has taken place, which constitutes the tumor of the arterial or venous pile, no palliative treatment will effect a cure. If hæmorrhage should be a prominent symptom in even these two last-named varieties, the same plan or plans of treatment as recommended for the capillary variety can be practised with success. In all such cases, however, an operation will be found necessary to effect a cure. Nothing less amounts to anything but temporizing or palliation.

#### OPERATIVE OR RADICAL TREATMENT.

After an operation is decided on, there are many plans or methods suggested, viz. :

1. Excision.
2. Ligature.
3. Clamp and cautery.
4. Dilatation of the sphincter muscles.
5. Galvanic cautery wire.
6. The use of acids and pastes.
7. The injection of carbolic acid, etc.
8. Whitehead's operation.

Several more plans might be named, but this list is quite sufficient to select from.

1. **Excision.**—It cannot be denied that the first-mentioned plan, excision, would be an ideal one if left to the expert to perform. Reference is not made here to the plan of excision as practised by Mr. Whitehead, but to the simple excision of the tumor itself. For the reason that it is tedious and accompanied by a good deal of hæmorrhage, it is not often performed. The writer has devised a clamp to be used in *excising* hæmorrhoids, which he thinks simplifies the operation and does away with its dangers. No cautery is used, the pile tumor being simply clamped, cut off, and the apposed surfaces sutured.

2. **Ligature.**—It cannot be gainsaid that the consensus of opinion is in favor of the operation by ligature for internal piles. It is the easiest of execution, the freest from danger, and the most radical in its results of all methods. It is the plan so highly recommended by Mr. Allingham and his confrères at St. Mark's, and it is the plan most frequently practised by American surgeons.

**3. Clamp and Cautery.**—There are some surgeons in Europe and a few in this country who prefer the clamp and cautery plan in treating for hæmorrhoids. The writer has employed it in a number of cases, but is forced to say that in his opinion it is not comparable to the ligature. The fact alone that bleeding might occur from a cauterized wound, which could not occur after a pile is ligated, is enough to condemn it. Mr. Allingham thus disposes of this plan of treatment: "This operation has little to recommend it. As a danger to life—after all, the issue of the greatest moment—as our most careful researches have led us to a conclusion, it is six times as fatal as the ligature properly and dexterously applied."

**4. Dilatation of the Sphincter Muscles.**—Upon a false premise as to the pathological change which goes to make up the hæmorrhoidal condition, the French have advised the dilatation of the sphincter muscles as a means of cure for piles. It is not reasonable to suppose that a tumor made up almost entirely of hypertrophic vessels, a mass of cell-growth, and abundant connective tissue could be dissipated by simply divulsing the muscle.

**5. Galvanic Cautery Wire.**—There was a time when the galvanic cautery wire plan of treating internal piles was much favored. It has fallen, however, into disuse and is supplanted by other and better methods.

**6. The Use of Acids and Pastes.**—Attention has been called to the fact that in bleeding capillary piles it is quite a good plan to fuming nitric acid to the granular surface of the pile. If this method had been limited to this class of patients, it would have proved to be of much service; but its application was extended to larger growths, and much damage resulted. It is very seldom successful and is limited to the kind of case indicated above. Pastes are of little service and often do harm.

**7. The Injection of Carbolic Acid.**—So much has been written about this agent in the treatment of internal piles that the writer will not take the space to discuss it; sufficient to say that years ago he pointed out the dangers to be apprehended in its use. In reference to the writer's opinion Mr. Allingham says, in his most excellent work on *Diseases of the Rectum*: "For our own part, we agree with the opinion of Dr. Mathews. We have tried the injection plan in many cases, but there was generally much pain, more inflammation than was desirable, a lengthy treatment, and the result doubtful—*certainly not a radical cure.*" Dr. Edmund Andrews, a distinguished surgeon of Chicago, reports the following accidents which occurred out of 3304 cases collected: "Deaths, 13; embolism of liver, 8; severe and dangerous prostration, 1; abscess of liver, 1; dangerous hæmorrhage, 10; permanent impotence, 1; stricture of the rectum, 1; violent pain, 83; carbolic acid poisoning, 1; severe inflamm

10; sloughing and other accidents, 35." The writer desires to add that in his practice he has seen a number of cases where stricture of the rectum resulted from this treatment, more than a score of abscesses and fistulæ, and other conditions equally bad. The consensus of opinion is that it is a dangerous and needless plan for treating hæmorrhoids.

8. **Whitehead's Operation.**—Several years ago Mr. Whitehead of England proposed a new operation for piles: it is, practically, to dissect out what he is pleased to call the whole "pile-bearing area." This necessitates the removal of about two inches of the lower rectum, then bringing down the gut and attaching it to the true skin. This operation has never found much favor with American surgeons. The following objections can be urged against it:

1. It cannot be advised except in selected cases.
2. An anæsthetic is necessary in every case.
3. Full and complete paralysis of the sphincter muscles is necessary to do the operation.
4. The operation is difficult, tedious, and bloody.
5. If union does not take place by first intention pus accumulates and invites sepsis.
6. The author recommends that the whole of the hæmorrhoidal plexus be excised, which is not necessary to effect a cure.
7. It can be maintained that secondary hæmorrhage is likely to occur after this operation, and the results given by the author do not justify his claims.
8. In a word, it is too much surgery when a simpler plan will result in a perfect cure.

It will be seen that the writer believes the ligature to be the best plan of treatment for internal piles. The special points to be observed during this operation are: Free divulsion of the sphincter muscle; thorough irrigation of the rectum, through a speculum, with a mercuric solution of 1:5000; bringing the tumor well down with volsella forceps; the ligature to be applied tightly at the base; the incision made in the true skin, and carried fully up the length of the tumor; and the hæmorrhoid cut off close to but at a safe distance from the ligature; antiseptic precautions before dressing, and antiseptic dressings after the operation.

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#### FISTULA IN ANO.

As far as surgery goes, the treatment of Fistula in Ano is much more important than the treatment of hæmorrhoids. The disease, too, is of much more significance. Hæmorrhoids constitute a local



affection, but fistula in this region may be due to a constitutional cause. Hemorrhoids very seldom affect the general health—except, perhaps, by bleeding, while fistula may so undermine the constitution as to seriously impair the natural vigor. All surgeons who have operated often for fistula are aware of the fact that it requires the most precise and delicate surgery to cure a complicated case of fistula in ano.

**VARIETIES.**—Almost all authors divide fistula in ano into the following varieties: *external*, *internal*, and *complete*—meaning by the external variety one that has an external but no internal opening; by the internal variety, one that has an internal but no external opening; and by complete, a fistula which has both an external and an internal opening. To the writer's mind this division is both misleading and inaccurate. By such classification no adequate knowledge can be had of the extent of the disease or of the amount of surgery which it will require to cure it. A patient may be present with a fistula which has the most insignificant external opening, and yet when the operation is performed it will be found that great destruction of tissue has taken place. A fistula may be *complete*, and be only a simple channel from the outside to the inside of the lower margin of the gut.

A much more significant division of fistulae would be: *progressive*, *non-progressive*, and *complicated*. Such a one would at least signify some idea of the pathological changes that had taken place, and indicate to the surgeon what he might expect in the way of an operation. Not only this, but some idea could be gained as to the necessity for operation, and whether it was imperative or not. Many times patients consult a physician for rectal disease and it is ascertained by examination that it is a case of fistula, but—what kind of fistula? It may be that the patient can ill afford to have an operation done at the time of consultation, and it is the physician's duty to say whether procrastination can be practised. To say that it is an *external*, or *internal*, or *complete* fistula would signify but little, but if he saw from unmistakable evidences that the disease was rapidly progressing, that other parts were being invaded, and that local destruction was threatened, he would advise that an immediate operation be done. If, on the other hand, it was observed that the fistula was a small affair, and was *non-progressive*, he could safely say that the operation could be deferred. If it was *complicated*—for instance, if inroads had been made into other organs, such as the vagina, bladder, labia, penis, etc.—a better idea would be had as to what operation or operations should be done.

As has been intimated, fistula in ano may be a very simple affair or it may be a grave disease. It has been the misfortune of the writer to see a number of cases that were inoperable because of the

vast destruction of tissue, and invasion of contiguous organs. Some fistulæ in ano are so rapidly *progressive* that delay is fatal, in so far at least as all future comfort is concerned. The guide in estimating the progressive nature of the disease is the amount of pus discharged. It may be, too, that much of it is confined, and having no external exit makes inroads by burrowing to internal structures. If there is not much suppuration it is safe to conclude that the channels are lined by the so-called "pyogenic" membrane, which prevents invasion of other parts. It must be remembered that pus is not a secretion, but that its presence betokens danger. Sometimes the term fistula in ano is a misnomer, for very few fistulæ in this region relate to the anus at all; many of them communicate with the rectum, and some fistulæ in this neighborhood affect neither anus nor rectum. The buttock may be extensively invaded, the perineum destroyed, or a sinus run high up the back or to the thigh-joint, and have no connection with the rectum. Hence in such cases as these the instruction of the authors, "to push a director through the sinus until it is felt in the rectum, then pull the distal end out of the anus, and divide all the tissue thereon," will not obtain.

Great stress is laid upon the importance of finding the internal opening of a fistula, before operating: so far has this fallacy extended that surgeons have been known not to operate in a bad case of fistula, because "the internal opening could not be found." This idea was founded upon a false premise, and should not be heeded at all. After the main cut for fistula is made it is an easy matter to trace the channel to an internal opening, if one exists. If the opening is not definitely located, the probe or grooved director is carried beyond it, and it would be included in the cut. Granting that it might escape the knife, the lymph thrown out as the result of the operation will be sufficient to close it.

*Abscess.*—It is a recognized fact that all fistulæ in ano begin with an abscess. Indeed, if physicians would remember this and treat the abscess in the proper manner the percentage of fistulæ would be wonderfully reduced. It is an aphorism in surgery that just as soon as pus is detected it should be evacuated, yet it is a strange truth that many physicians when they meet with abscesses around the rectum will advise the patient to "allow it to break" of its own accord. This would have been poor surgery many decades ago, but in this day of antiseptic surgery it is inexcusable. Around the rectum is a rich field for sepsis, securing as it does an abundant blood-supply, and a free distribution of lymphatics. No abscess should be allowed to go an hour without complete opening and free drainage; especially is this true of abscesses around the rectum, which are followed in such a heavy percentage of cases by fistula.

Although it is a recognized fact that abscess in this region generally ends in fistula, it has been a point for discussion why it should be so. Many account for the fact by the statement that the circulation here is feeble, because of the absence of valves. A factor of great importance is that the tissues are soft, and often flabby, and are unable to offer great resistance to the inflammatory process, and constitute poor ground for repair. Besides, it must be remembered that certain diatheses or cachexias render these tissues peculiarly susceptible to the destructive process of inflammation. But even in a healthy condition the inroads from the inflammatory deposit are often such as to make an active and destructive condition which unless heeded at once ends in a serious complication of affairs.

The injunction to open the abscess around the rectum early and sufficiently is of paramount importance, and the second, to secure thorough drainage, is of nearly equal importance. It will often be necessary to give the patient chloroform to accomplish this.

CAUSES.—In speaking of or considering the causes of fistula in ano, the question really is, What is the *cause* of the abscess which invariably precedes the trouble? Fistula, in fact, is but the sequel and the abscess the real cause. As has been mentioned, the enfeebled circulation caused by deficiency of valves plays a part, no doubt, in the formation of abscesses in this locality, and the same reason may be productive of changes which prevent the healing of the same, hence giving rise to fistula. In a paper read by the writer some years ago, before the American Medical Association, on the subject of fistula in ano, he ascribed to the contraction of the sphincter muscle a power to prevent the healing process of an abscess contiguous to the rectum or anus, and suggested that in opening these abscesses it would be a good idea to freely dilate or paralyze the muscle.

Amongst the many causes which tend to produce fistula may be mentioned trauma, foreign bodies in the rectum, irritation from diarrhoea or dysentery, pressure of the child's head during labor, impressions made by extreme cold, etc. But it must not be forgotten that special diatheses play a great part. The tubercular subject is especially liable to abscesses around the rectum. It is not intended to convey the idea that these are, pathologically, true abscesses, yet the condition ends in fistula, and that is the disease under consideration. How to deal with such a condition will be considered under a separate head. In a word, fistula is caused by an abscess, and an abscess is caused by the germ of suppuration.

#### SYMPTOMS AND DIAGNOSIS.

Fistula in ano is easily diagnosticated, for in remembering its pathology search is at once made for the sinus or the physical signs



of it. The symptoms of an abscess, which is the initial stage of fistula, are very decided, especially if of the acute variety. All the symptoms of inflammation are usually present, great pain, redness, heat, swelling, and tension. The appellation "cold abscess" is a misnomer and should never be used. All such are of *tubercular* origin. It is well to remember that fistulae are oftentimes secondary to, and caused by, an ulceration, or ulceration and stricture, of the rectum. In all such cases, of course, the primary disease must be treated first. After the abscess is lanced or broken, in a certain percentage of cases no fistulae will follow, but in quite a heavy percentage it will result. The first symptom that the patient will notice is a discharge from the sinus or opening which he has detected. In the female, especially, it will be the soiling of the linen that has attracted attention. It will be imagined by the patient that the "old disease" has returned, and censure of the physician will likely follow, for not having cured the abscess. It is well, whenever an abscess around the rectum is treated, to warn the patient that fistula may result. If it does not the physician gets the credit of curing the disease, and if fistula should follow he is fortified by a good prognosis.

When the patient has explained his symptoms, an examination should at once be made. An ocular inspection of the parts will reveal a good deal. If an external fistula exists, it can be seen, and if no external opening can be detected it may be that it has but recently closed. Sometimes the patient will give the history of the sinus "weeping" for a time and then ceasing to do so. This is accounted for by the fact that the external sinus closes and reopens. If this is the condition of affairs, or if there is no external opening, a closer scrutiny of the parts should be made. It will then likely be discovered that the pus discharges from the rectum. If a history of abscess has been given it is now safe to conclude that an *internal* fistula exists. In such a case the finger should be inserted into the rectum and perhaps the opening can be found. If not, by the use of a speculum and a good light the oozing of the pus from a certain point will indicate the internal opening. In either of the varieties of fistula, a "cord" can be felt and traced by pressing gently over the surface externally. This is the channel, and the course can often be made out by touch. By taking a probe and inserting it into the external opening and allowing it to find its way with only gentle pressure, it can sometimes be determined whether it is complete or incomplete. In this, however, the physician is often misled, for the channel may be complete but is so tortuous as to baffle any effort at the introduction of the probe. What has been said in regard to the useless attempt to locate the internal opening can be made to

apply to the effort to determine the course of the sinus, or the number of sinuses. This will be determined during the operation.

By the majority of physicians, fistula in ano is regarded as a simple affair, and it is expected that the disease will be found always as one of the three divisions mentioned in the books. So great is the diversity of character of fistula that no accurate description can be given of this disease except in a general way.

**Tubercular Fistula.**—Time was when it was believed, nearly universally, that to operate upon a tubercular patient for fistula in ano was grossly improper. Even more—that to operate upon the *healthy* subject for the disease was wrong. The idea prevailed that there was such intimacy between the lungs and rectum that if the discharge from fistula ceased, whether by operation or otherwise, it would “go to the lungs.” Many people to-day hold to this old theory, and it is not uncommon for patients to ask the question, “If I have my fistula cured, won’t I have consumption?” In the light of modern investigation one might say, “If you do *not* have your fistula cured you may have consumption.” Tissue everywhere is likely to take on tubercular change. There is no exception to the rule from the top of the head to the sole of the feet. Tubercular disease in its various phases may be seen and recognized in any general hospital affecting the scalp, the bones, the joints, the tissues, the muscles, etc. The neighborhood of the rectum is not an exception, but on the contrary is frequently the seat of tubercular deposit. It is well recognized to-day that tuberculosis may be a local disease, from which the general constitution may become infected. Hence it is that when this local condition is detected, the surgeon immediately attempts to prevent further invasion by removing the affected part. If it is a knee-joint it is excised; if bone, it is removed or scraped; if the rectum, in the form of fistula or ulceration, it should either be curetted or trimmed out.

The diagnosis of a tubercular fistula is comparatively easy. The opening is large and flabby, allowing the finger to enter oftentimes with ease. The tissues surrounding are pale, the blood-distribution very feeble—to such an extent that when the tissues are divided very little bleeding occurs. In addition to the physical signs a specimen should be subjected to the microscope for the detection of the tubercle bacilli. It is true that in many cases the bacillus is not found when the disease actually exists, yet if it is observed it aids in the diagnosis. Other signs which can be noticed are: the sphincter muscle is weak, the tissues around the opening are undermined, the edges of skin around the opening blue and pale.

In regard to operating upon a phthisical patient who has fistula, there are just a few points to be considered: If it is a case of rapid



phthisis, and the patient has but a short time to live, no surgeon would think of adding additional pain and inconvenience by operating upon any fistula that might exist. But these cases are the exception, for, admitting that one has phthisis, its progress may be very slow indeed, and many subjects of the disease are cured. If such an one has a fistula in ano, which is giving him great distress, it would be foolish not to give him relief. But fistula in ano, tubercular in character, may exist and be purely local, and by remaining the disease may become general. By removing the local foci we get rid of the germ of infection. The writer has seen a number of cases of tuberculous fistulæ, with ugly ragged edges, overlapping an ulcerated surface, perhaps just at the verge of the anus, embracing the fibres of the sphincter muscle and causing great pain. He has been gratified in such cases by seeing all distress abated after operation.

In the patient who has fistula complicated with phthisis, if an operation is done he should not be kept in bed, but should get about again in the shortest time possible. The recumbent position excites to coughing and thus militates against the healing process. It is much the best to assist him to walk out in the open air, even if a large wound exists. These patients should be fed on good nutritious diet all the time. The old impression that the wound would not heal in the tubercular patient is fanciful, for oftentimes the most beautiful results are obtained. Many patients complain much more of their fistula than of their lungs, and to these great relief comes not only physically but mentally as well. The writer cannot concur in the opinion expressed by some authors, that as long as the fistula is insignificant and discharges but little, it should be left alone. The question in such a case to determine is whether the fistula is of tubercular origin: if so it should be removed; if not it could be left alone.

#### OPERATIVE TREATMENT.

There is but little palliative treatment for fistula. In the great majority of cases nothing but an operation will effect a cure. The abscess, which is but the forerunner of fistula, can be palliated, so far as the pain is concerned, by the application of heat, etc., but even here it is much the best plan to resort to surgery by lancing it freely. In regard to operating for fistula it should be first determined what kind of fistula exists. As has already been intimated, the opening, either external or internal, betrays but little as to the extent of the disease. The injunction to divide the tissue upon the director will hold good only in those cases where the track is single—not complicated by diverging sinuses. It would be a most difficult matter to say just what amount of surgery would have to be done in any single case. Indeed, very few cases of fistula are alike.



As to the methods they can be included under the following heads: (1) Injections; (2) Elastic ligature; (3) The knife.

**Injections.**—Patients, as a rule, are very averse to the use of the knife, especially in rectal affections. This antipathy has been brought about by the advertising charlatan, who proclaims a cure for all such affections without the use of the knife. Of course this is the veriest nonsense, yet many are enticed into their care by such representations, or rather misrepresentations. Can fistula in ano be cured without surgical means? The question must be answered in the negative in so far as the majority of cases are concerned. Some of the older writers mentioned the plan of injecting the fistulous sinus with some agent which would excite to the granulatory process, and by this means close the channel. It was, therefore, suggested to inject into the opening, by means of a small syringe, iodine, solution of silver nitrate, diluted acids, etc. This plan is still vigorously followed by some quacks in order to bear out the assertion that the knife is not used. To say that this manner of treating fistula is of but little account is putting it mildly, for instead of benefiting it would very often be productive of harm. No gauge can be set upon the amount of the caustic that is used, and violent inflammatory action might be excited, sufficient to cause an abscess and thereby add to the trouble. It is true that the external opening may sometimes be closed by the use of such agents, but that is just what is not desirable. By so doing pus would be confined and additional sinuses would form. It can be definitely said that the effect of all such methods is conducive of harm rather than good.

**Elastic Ligature.**—It was Professor Dittel, of Vienna, who first suggested the use of the elastic ligature for the cure of fistula. Had the professor lived in this day of aseptic surgery it is to be doubted if he would have made the suggestion. Certainly it cannot be claimed for the operation that it is aseptic, and that is what is most desired now in all surgical operations. The method consists in putting an elastic cord through the external opening, catching it in the rectum, pulling it out of the anus, and running a piece of lead with a hole cut in its centre over the two ends and tightening sufficiently to cut out. Many devices have been suggested for doing this, but the writer has found the simplest and best to be a grooved director with an eyelet, or hole, through the end of which the cord is passed. The objections to this plan suggested by Prof. Dittel are manifold:

(1) It is unsurgical. From all fistulous sinuses pus exudes, and the introduction of a foreign substance (the ligature) excites to an increase of it. It is impossible to irrigate the channel or apply any antiseptic to it during the progress of the cutting by the cord.

(2) There is no means of telling whether the sinus is a simple one

or not, and in the majority of cases there are diverging tracks. It must be conceded, then, that each individual sinus must be treated in like manner, which would prolong the cure indefinitely. What it would take the ligature, therefore, weeks to accomplish, the knife could do in a few minutes.

(3) It is painful and annoying. Some writers have claimed that very little or no pain accompanies this plan. It is not reasonable to suppose that several inches of tissue embracing the sphincter muscle could be cut through without pain, and this has not been the experience of the writer. Add to this that the discharge is continually soiling the linen, and it can easily be seen that it is anything but comforting.

**The Knife.**—It must be firmly impressed that fistula in ano is often a most serious surgical affection, and that it requires in many cases desperate surgery to effect a cure. It is no uncommon thing to find as many as twenty or more different sinuses leading to important structures and of great length. For practical use the external sphincter muscle is the most important in the body, and this is to be dealt with in any and all operations for fistula in ano. True, many of these cases are simple ones and require but little attention, but it must be borne in mind that these are the exception. The surgeon who believes that he can always cure fistula in ano by one single operation will find himself greatly deceived. In the first place it may not be desirable to complete the operation at one sitting, because of the damage which would be done to the sphincter. Secondly, however careful he may be, an undiscovered sinus may exist and prevent the operation's being successful. A patient might forgive an unsuccessful attempt at cure, but would never forgive being left in such a condition after the operation that he could not control the actions from his bowel.

The first step to the operation by the knife is to have the parts in as nearly an aseptic condition as possible. It may be urged that this is impossible, for the reason that we are dealing with a pus-disease. But it must be remembered that fresh wounds are to be made, and that the rectum is a favored spot for sepsis. Again, the office of the rectum—to receive the feces—makes it a difficult part to be thoroughly cleansed and to be kept so. Notwithstanding these facts every precaution should be taken in order to do just as clean an operation as possible. Irrigations with mercuric solution and the use of iodoform dressings should not be neglected in any operation for fistula.

The principal advantages that the knife has over every other method of operating for fistulæ are: Every sinus can be sought out and divided; overlapping edges can be trimmed away; the operation is done quickly; and the wound can be dressed antiseptically.

The chief admonition for operating for fistula is to lay freely open

every sinus, or the result will be a failure. It might be presumed that by plastic deposit an additional sinus would be obliterated, but experience teaches to the contrary. These channels are lined by a tough, elastic membrane which resists the healing property of the inflammatory product.

Compared with all other methods practised for the cure of fistula in ano, the knife is the most surgical, most efficient, and the best.

### STRICTURE OF THE RECTUM.

STRICTURE of the Rectum is one of the most serious conditions met with in that portion of the gut. It can be safely asserted that when caused by other than benign conditions it is incurable save by radical means, and then seldom so. The following is the usual classification: 1. Acquired; 2. Spasm; 3. Dysenteric; 4. Tubercular; 5. Inflammatory; 6. Traumatic; 7. Venereal or Syphilitic; 8. Malignant.

The first term used, ACQUIRED, is, to say the least of it, a very vague one. One can imagine how a stricture the result of venery could be acquired, but it would be difficult to conjecture how a spasmodic or cancerous stricture could be acquired. If such a classification is given it would be best to include it in a *congenital* variety.

SPASM.—If a stricture of the rectum ever really exists from spasm it should not be classified, because no pathological change exists. It would be only a symptom of disease elsewhere. Again, it seems impossible for the lumen of the rectum to be so materially affected by spasm as to constitute, or resemble, a stricture.

DYSENTERIC.—Dysentery is regarded as a frequent cause of stricture of the rectum. The writer, after a long experience in rectal surgery, cannot agree that it is so. Very many cases present themselves with symptoms of dysentery that have stricture, but upon investigation it will be ascertained that the dysentery (?) is the result of and not the cause of stricture. The process of ulceration after dysentery is not usually observed in the rectum, but in the colon, and it is here that the contraction would take place. Surgeon-General Woodward writes that he had carefully searched the Pension Office for the record of a case where a pension was drawn for the existence of a stricture of the rectum the result of dysentery contracted during the war, but could not find a single one. Certainly dysentery is not a *common* cause of stricture of the rectum.

TUBERCULAR.—As has been affirmed, the tissues around the rectum are often the seat of tubercular change, ulceration, etc., but it is quite another question whether stricture often results from this cause.



The nature of tubercular tissue is to break down, and it would appear that in the capacious rectum this change would take place before the gut was constricted.

**INFLAMMATORY.**—The term inflammatory is so broad and comprehensive that per force of reason it must be admitted that it is a common cause of stricture. May it not be asked if it is not the *only* cause of stricture? It would be difficult to understand how a stricture could be formed—this being always by deposit—without the process of inflammation going on. It matters little what the variety—trauma, pressure, dysentery, cancer, tuberculosis, syphilis, or what not—this suggestion obtains. Even a simple cicatrix, which would contract the gut, could not exist save by inflammation. Proctitis is nothing save an inflammation of the walls of the rectum, and it should not be said that a stricture is the result of proctitis, but that proctitis is the result of inflammatory deposit. What excites to this proctitis is another matter, and sometimes difficult to tell.

**TRAUMATISM.**—Under the head of traumatism it is common to name ulcerations following operations or wounds above the rectum. Of course traumatism excites to inflammation, and inflammation to a deposit, and the deposit to contraction—hence stricture. But, after all, this is inflammatory, and the pathology is found in this process.

**VENEREAL.**—Under the head of venery, as a cause of stricture of the rectum, three conditions are mentioned: chancreoid, secondary, and tertiary ulcerations. Fournier describes an unusual form as resulting from a gummatous deposit. It is certainly not shown that stricture of the rectum is due to the extension of chancreous pus, nor that it results from unnatural intercourse. The writer in his book on diseases of the rectum<sup>1</sup> attributes 60 per cent. of the strictures of the rectum to syphilis. Not in the way of chancreous extension, or unnatural intercourse, but to changes which take place the result of cell-proliferation—an “anal-rectal syphiloma.” Further experience has not changed his opinion, but confirmed it.

**MALIGNANT.**—In all cases of cancer of the rectum stricture will be detected at a certain stage. The hyperplasia, gradually increasing, infringes on the walls of the gut and narrowing takes place. It is very seldom that a physician sees a case of cancer of the rectum until a decided contraction has taken place.

#### SYMPTOMS AND DIAGNOSIS.

The symptoms of stricture of the rectum are very insidious indeed. It is a remarkable fact that strictures often exist which would not permit the entrance of a lead pencil, and yet no special symptom is complained of except constipation; this is especially true of the

<sup>1</sup> *Diseases of the Rectum, Anus, and Sigmoid Flexure.*

syphilitic form of stricture. If, however, the passages are observed a discharge can be seen which is either mucus or pus, or is mucopurulent, and sometimes a slight amount of blood. Pain is not often a factor in the venereal stricture, and the same may be said of strictures from benign causes the result of simple inflammation. In cases of stricture the result of cancer the reverse is often true, the pain being very severe—sometimes constant, sometimes exacerbating. If the malignant growth is well above the sphincter, it will be observed that pain is not nearly so severe as when situated within the grasp of the muscle.

The only correct way to properly diagnosticate a stricture of the rectum is to introduce the finger. If within reach it is easily detected, and in the vast majority of cases strictures are within reach of the finger. The clinical history of the case must reveal the character of stricture. Sometimes the microscope can be used to advantage.

#### TREATMENT.

There are numerous plans recommended for the treatment of stricture of the rectum. They can be summed up in these: 1. Dilatation (gradual or forcible); 2. Incision; 3. Electrolysis and Racelage; 4. Excision; 5. Colotomy.

**Dilatation.**—Although recommended by many, *gradual* dilatation will be found less serviceable than *forcible*. The chief advantage in the latter is that the stricture can be broken to the full capacity of the gut in one sitting, while with gradual dilatation it would require months to accomplish this much.

When it is remembered that stricture of the rectum is located nearly invariably within three and one-half inches of the outlet, it can be readily seen that the danger in forcible dilatation is nearly *nil*. When gradual dilatation is practised, constant irritation is kept up, which favors plasma, and if the process is left off a little time, recontraction occurs. If a stricture is located high up in the rectum—in the movable gut—it is dangerous to attempt dilatation by any method.

**Incision.**—In certain forms of stricture the incision plan is to be highly recommended. There are two methods, called respectively *internal* and *external* proctotomy. The internal is, in the writer's opinion, to be preferred. It is urged for the external that it is best in order to get proper drainage. Even if this were true the ill effects of a complete division of the sphincter muscles would outweigh the objection. Internal proctotomy is not dangerous when properly performed; and the writer has never had periproctitis follow after practising it. Of course antiseptic precautions are to be followed as strictly as possible.

**Electrolysis.**—The method of treating stricture of the rectum by electrolysis has not met with great favor in the United States, but is advocated with great earnestness by a few. By its advocates the following advantages are claimed :

(1) That electrolysis in the treatment of stricture is not a panacea ; on the contrary, failures may happen and will irretrievably fail if the stricture is due to carcinoma.

(2) Electrolysis will give improvement when all other methods fail.

(3) Electrolysis will cure a certain percentage of cases without relapse, and without the necessity of an after-treatment or the use of bougies.

(4) The best chances for a cure are with fibrous inflammatory strictures.

**Excision.**—To the surgical mind, excision of a stricture sounds ideal, yet there are many things to be considered before it would be attempted. First, the etiology of the stricture must be defined before the plan of treatment is adopted. Where a simple fibrous band is stretching partly around the lumen of the gut, the simplest thing would be to divide it. If it is of tubercular origin, it would be impracticable to excise it ; and if it be a stricture caused by either syphilis or cancer, the operation would amount to an extirpation. It must also be considered that to excise a stricture, the sphincter muscle must be involved in the operation, and the results must be anticipated. Extirpation will be considered under the head of Treatment of Cancer.

Bacon has devised a plan by making a new channel around the stricture by folding the gut above the constricted portion down over the stricture and anastomosing it with the rectum below the contraction, afterward clamping away the septum that has formed.

**Colotomy.**—Whatever might be the nature or cause of stricture, the strongest advocates of colotomy could not plausibly advocate it as long as the patient could have a moderately free evacuation from the bowels, and there was no danger from hæmorrhage. Pain is rarely so excessive, even in cancer of the rectum, as to justify colotomy, especially if the bowels move freely. If the question of colotomy is upon the propriety of operating for stricture *per se*, it might be answered that where total or nearly total obstruction exists and the stricture is in the movable gut, beyond the reach of the finger, colotomy is advisable. Stricture the result of syphilis is an ideal condition for this operation when located as herein stated.



### CANCER OF THE RECTUM.

OF all affections of the rectum, cancer is the most serious. Unfortunately, too, it is scarcely ever met in its incipency, and the chance for a cure is lost, or at least is a minimum.

The medical world is still in the dark in regard to the cause of cancer, in the rectum or elsewhere. Many pages have been written in advocacy of the position that the disease is hereditary, and others are equally of the opinion that heredity plays no part. It is believed that a long-continued local irritation is conducive to malignancy. Future investigations may upset all theories of the present in regard to the cause of cancer. The consensus of opinion is that age plays a part in the development of the disease, it being said that middle life is the favorite time, then advanced age. The writer has reported several cases in patients under seventeen years of age. Women are said to be more liable to cancer than men. This may be true so far as the body as a whole is concerned, but there can be no reason why they should be more exempt from cancer of the rectum.

It is not the intention of the writer in this short space to enter into a discussion of all the classifications of cancer of the rectum, or to go into a debate on its nomenclature, but rather to mention only the practical points. For all purposes the term *adeno-carcinoma* is quite sufficient, for the other varieties can really be included under this head, pathologically and microscopically. A further classification would also divide *adeno-carcinoma*, which would be confusing and be of no practical utility. These fine points can be decided after the removal of the growth rather than before.

### SYMPTOMS AND DIAGNOSIS.

Cancer of the rectum is a most insidious disease, often in its incipency presenting no symptoms worth mentioning. It is only after the growth has existed for some time that any positive evidences of cancer are given. Among such signs may be mentioned the pale and waxy aspect, the peculiar odor, disposition to bleed, frequent stools, muco-purulent discharge, etc. Pain sometimes is intense, and at others not sufficient to be called a factor, and when it does exist there is generally violent straining at stool, which is distressing.

### TREATMENT.

It might be said that as regards treatment of cancer of the rectum the reverse of an axiom in surgery would obtain. Ordinarily in diseases requiring extirpation it is advisable to wait for the full development of the disease, and to use palliative measures until it does mature. In cancer an operation would be advisable during the

incipiency of the disease, and palliative measures discarded. But the affection being so slow to manifest itself, all chance to operate has passed when the diagnosis is made, and nothing is left but to palliate.

If the cancerous mass protrudes from the anus, a free application of powdered burnt alum will have the effect of reducing it. Another excellent application is arsenite of copper with mucilage, as a paste. After all, what the patient desires in the way of palliation is relief from pain, and of all the remedies to accomplish this opium in some one of its forms is the best. The writer can see no objection to prescribing this drug freely, where the case has been decided to be an inoperable one. If the life of such an unfortunate can be made in any way comfortable by the use of opium, he should have it. Some other things should be looked after, such as diet, position, and especially the keeping of the parts free of débris, by frequent irrigation with antiseptic solutions. If a close stricture is within reach, and is obstructing the passage-way it should be divided, and sometimes a free curettement will do good by relieving nerve-pressure.

**Operation.**—The writer is on record as opposing either one of the operations for cancer, *excision* and *colotomy*, except in the rarest of cases. If the cancerous patient can have his actions in a moderate degree of comfort, and there is no risk of life from hæmorrhage, there could be no logical reasons for doing a colotomy. If pain is urged as a reason for the operation, it could be answered that much could be done for the relief of pain by doing one of the minor operations. It must be admitted, even by the most vehement advocates of colotomy, that the operation is really nothing less than a palliative means. The diseased structure is left to go on with its ravages without any hope of cure. The operation is not a pleasant one to contemplate, to say the least of it, and though it may and does relieve pain in some cases, in many others it fails to do so. Then it might be urged that opium would accomplish this without an operation.

As to excision of cancer, as has already been said, it is the ideal method of treatment *provided* that the whole cancerous mass can be enucleated. But the question is, Can this be done? Surgeons of much experience in dealing with cancer of the rectum say that this can rarely be accomplished. The rectum is so abundantly supplied with blood-vessels and lymphatics, that it forms a suitable bed for absorbing and propagating the cancerous material, that by the time the surgeon sees the case, contiguous organs have been involved and gland-infiltration has taken place.

Of what avail is it to remove a portion of the rectum, when the whole of it is involved? What is accomplished if the whole is removed, if other organs are implicated. There must be a line drawn—outside of the age of the patient, physical conditions, etc.

The matter should be settled whether really there is any chance of cure, before submitting a patient to either of these radical procedures. Of course, if by colotomy life can be saved, or great pain relieved, the operation would be warranted; or if by excision the whole mass could be removed and leave other organs unaffected, it would be justifiable.

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### PROLAPSE OF THE RECTUM.

In the adult, prolapse of the rectum is infrequent, but it is often met with in children. Prolapsed hæmorrhoids are sometimes mistaken for true prolapse of the bowel, and oftentimes there is some prolapsus with an aggravated case of piles. Then, too, there is a vast difference in the character of prolapse. In one variety only the mucous membrane is involved, while in another all the coats of the bowel, and often the peritoneum, help to constitute it. In forming an opinion as to which variety exists, the size and the history play a part, and taxis will reveal a good deal to the expert surgeon. The mucous-membrane variety signifies no danger either in treatment or otherwise, but in dealing with the second variety danger is to be apprehended.

#### SYMPTOMS AND DIAGNOSIS.

The most positive symptom of prolapse is of course the protrusion of the bowel at stool. Children not being subjects of piles, any protrusion of the bowel at stool would indicate either a polypus or prolapse. In the adult this protrusion should be carefully inspected in order to differentiate between hæmorrhoids and true prolapse. Straining at stool causes the nurse to observe that something is the matter, and by ocular inspiration a small red tumor is seen pushing through the anus. By taking hold of it, it can readily be told whether it is a polyp or prolapse.

#### TREATMENT.

The treatment of prolapse is both palliative and operative. In children especially, the cause should be looked after. With this class of patients the most common cause will be found to be pin-worms. Anything that excites to an irritation and violent effort at straining will produce the affection and should be sought for.

The best manner of treating prolapse of the rectum in a child is the following: Administer a dose of castor oil; after it acts give a high enema of salt water, then a dose of paregoric; apply adhesive straps across the two buttocks, bringing them firmly together. Put the child to bed for one week; on a light diet; on the fifth morning give a dose of oil. Remove straps when bowels move, which should be



in the erect position ; wash out the bowel with cold water, and keep stools gently soluble and open. In the majority of cases this plan will succeed in curing prolapse in the child, and some suggest washing the prolapsed bowel each time with some astringent, but it seldom accomplishes the purpose.

The mildest operative treatment is that suggested by Van Buren, which consists in applying the actual cautery at a dull-red heat to the tumor in stripes radiating from above downward. To do this requires the use of an anæsthetic and looks a little barbarous. The writer has never had to resort to this treatment in children, but has used it several times in the adult with moderate success. For the treatment of an old or chronic prolapse in the adult, especially in the aged, a much more radical method has to be adopted. It has been suggested to amputate the entire tumor.

It will be found that, in the aged, prolapse of the rectum does not give as much distress as one would imagine, and before deciding upon so radical a procedure as the removal of the entire tumor the surgeon should give serious thought. Many of us have seen such a "tumor" assume the proportions of a man's head, and yet the patient complain very little from its effects.

Since the first edition of this book was issued, the writer has performed an operation, comparatively new, for an enormous prolapse of the rectum, with a very gratifying result. The abdomen was opened in the left inguinal region, the rectum was drawn fully up, and the colon was sutured to the abdominal wall. The procidentia was complete, embracing all of the rectum, and the bladder was included in it, making a tumor when protruded as large as a man's derby hat. There has been no recurrence of the prolapse since the operation.

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### RECTAL POLYPI.

It would be quite an easy matter to mistake a rectal polyp for prolapse of the bowel, in an infant, if an examination was not made. The nurse would be apt to say in both instances that a "small red tumor" was presenting at the anus. By examining, the difference can be easily told, as the polyp has a distinct stem or pedicle, while prolapse takes in the entire circumference of the bowel. Polypi are often found in children, but it must not be supposed that they are confined to this class. In the adult these tumors sometimes are of very large size, and have a stout pedicle. They often exist at the same time with other affections of the rectum, notably piles. In searching the gut for them, the effort must be very thorough, as they

often elude the finger. Whatever their size, character, or location, the only treatment is to remove them. If they can be caught, held, and ligated, this is undoubtedly the best, as this tumor is sometimes supplied with a large-sized artery. If this plan is impracticable, then the polyp should be twisted off and the case watched for hæmorrhage.

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### PRURITUS ANI.

ONE of the most distressing affections of the human body is a pronounced case of pruritus ani. Patients who suffer from it often say that they would much prefer to endure pain than to suffer from the intolerable itching. No class of people is exempt, for the rich bring it on by excesses in both eating and drinking, and the poor perhaps by other habits equally productive of it. Age has but little influence, although it is most commonly found in middle life, and it pays no respect to sex, as both the male and female suffer from it. Sometimes it exists in a very mild degree, at others it is of the most tormenting character.

Pruritus ani often appears as a distinct eczema, but more frequently nothing can be seen to indicate any pathology. Whilst pruritus may and does often affect other portions of the body, the anus is the most favored seat. When present, it is aggravated by certain articles of diet, by smoking, by drinking alcoholic liquors, by excessive venery, by eating peppers, etc., but it is doubtful if any one of these is ever the direct cause of the trouble. It is most intense when the parts are heated, hence is worse after the patient has retired for the night and has gotten warm in bed. The disposition of the affection is to localize itself, but in some instances it extends to the scrotum, buttocks, and far down the legs. If it has existed for a long time, by inspection a distinct scarf-skin can be seen—white, glistening, and very smooth. After treatment the disease will often disappear, and the patient will express himself of the conviction that he is entirely cured, but from the slightest indiscretion in diet or drink it will suddenly appear again.

### TREATMENT.

The first thing to do in a case of pruritus is to inquire after the habits of the patient: whether he is an over-eater; indulges in alcoholic or malt liquors; is a tobacco-user; is a man about town, and indulges his sexual appetite to an abnormal amount; is a drinker of tea or coffee. Each and all of these should be interdicted before

treatment is begun. It may be that some special article of diet brings on an attack, and this should be carefully investigated by the patient. Obstinate constipation may have something to do in producing or keeping up the trouble; therefore this should be corrected by the use of aperients. The following is a good laxative:

R. Sulphur. sublimati,  
Potassii bitartratis,                   āā. ℥iv (120.0).—M.  
Sig. Teaspoonful in glass of water, before breakfast.

It is also well to look to the secretion of the kidneys, to the amount of urine passed, and the constituents of the same. When loaded with the oxalates or urates, a disposition to itch is often established. In a general way it is well to advise the patient to take frequent hot baths, especially at night before going to bed. The Russian or Turkish bath will be found of excellent utility in protracted cases of pruritus. If the patient is "run down" in health, it is all-important that he be built up; especially is this true if there is any special diathesis manifest, as syphilis, tuberculosis, etc. For these, special treatment should be accorded, such as small doses of bichloride of mercury, potassium iodide, cod-liver oil, iron, etc. In another class of patients it will be found that the nerve element plays an essential part, and the neurotic symptoms must be ameliorated. It is a difficult matter to map out any definite plan of treatment, as nearly all cases of pruritus are individual ones and must be thoroughly traced and then prescribed for.

As to local applications there are hundreds, many of which are claimed by some to be specific in their action, but which after a few trials will be thrown away by others. In cases that partake of the eczematous variety, Dr. Bulkley recommends the following:

R. Liq. carbonis detergens (Wright's),                   ℥j (30.);  
Glycerini,   ℥j (30.);  
Zinci oxidi,   ℥ss (15.);  
Pulvis calaminæ præp.,                                   ℥ss (2.);  
Aquæ,   ℥vj (180.).—M.  
Sig. Apply with brush and allow to dry, daily.

In this variety, also, pastes are sometimes to be preferred to solutions or ointments, such as—

R. Hydr. chlor. mit.,  
Bismuthi subnit.,                   āā. ℥ss (15.).—M.  
Sig. Dust on parts, or rub in with finger frequently.



One of the best of agents to stop itching is ichthyol :

R̄. Vaselinei,	3j (30.) ;
Ichthyol.,	3j (4).—M.
Sig. Apply.	

Or,

R̄. Ungt. aquæ rosæ,	3j (30.) ;
Menthol.,	3j (4).—M.
Sig. Apply morning and night.	

When other remedies fail, bichloride of mercury either in solution or ointment will give good results :

R̄. Vaselinei,	3j (30.) ;
Hydr. bichlor.,	gr. viij (0.52).—M.
Sig. Apply.	

Suppositories, as a rule, do not accomplish much in these cases, but the writer has derived benefit from the following :

R̄. Cocainæ hydrochlor.,	gr. iij (0.195) ;
Ol. theobromæ,	q. s.
M. ft. in suppositoria No. vj.	
Sig. Use one at bed-time.	

In lieu of all ointments it will, with a certain class of these patients, be found best to use powders or dry dressings, such as calomel, bismuth subnitrate, starch, etc. In the moist variety the patient should be advised to wear a well-adapted pad of oakum against the anus. When the disease resists all such local treatment, a more radical method is the use of the galvanic cautery, curettement of the surface, the application of pure carbolic acid, tincture of iodine, or campho-phénique. It should not be forgotten that a neurotic element may predominate, and nothing will cure until this element is dissipated and the general health is built up.

The writer has devised a method of treating these inveterate cases of pruritus ani, which has proven to be eminently successful. It consists in making a clean dissection of all the involved tissue, including the lower inch of the rectum.

## FISSURE OF THE ANUS; IRRITABLE ULCER OF THE RECTUM.

A DISTINCTION should be drawn between a fissure and an irritable ulcer. Most books speak of fissure of the rectum; this is a misnomer and anatomically incorrect: a true fissure could not be formed in the *rectum*, but the anus is the common seat of such trouble. The rectum, however, is the seat of irritable ulcer, and the reason for so calling it is that the ulcer falls within the grasp of the sphincter muscle. Ulcers are often found above this muscle which are not painful in the least although of good size. A fissure is a simple crack, or break, in the mucous membrane, at the verge of the anus, caused by a tear, likely, in passing hard fecal matter. Of course any trauma of the parts might give rise to the disorder. At first the abrasion presents acute symptoms, as a fresh wound would, but after a while the pathological changes which constitute an ulcer take place. This fissure-ulcer, therefore, is oblong in shape, while the irritable ulcer is oval and situated higher up. Of course a fissure is irritable, but a contradistinction must be made in order to treat the affections rationally. Fissure of the anus is the most painful of all rectal diseases, except, perhaps, some cases of cancer in the same region. Indeed, many persons who suffer from fissure are firmly persuaded that they have a malignant growth. It is strange, too, that patients, especially women, will suffer the agonizing pain of fissure for years without consulting a surgeon. An ointment is used, and the disease may for a while seem cured, when suddenly after a stool the same terrible pain is experienced.

In the majority of cases of fissure, it is difficult to trace it to any definite cause. The use of printed paper as a detergent can be set down as one of the causes. Some people are in the habit of using hard and irritating substances for this purpose, as wood, splinters, corn-cobs, weeds, grass, etc. These, of course, may set up inflammatory action or cause a break in the mucous membrane which would result in fissure. The affection is common in syphilitic children. The childbearing woman is said to be a subject of fissure, though the writer has seen but few cases of fissure in the recently delivered woman.

If a polypus of the rectum exists with a pedicle sufficiently long to allow the tumor to protrude at stool, this would be a pronounced cause for fissure. It is well in all cases of fissure to examine the rectum not only for polypi, but for other things which may be the primary cause. Some authors speak of fissures resulting from surgery around the rectum, notably for hæmorrhoids, but in the writer's whole experience he has never seen such a case. Nor can he subscribe

to the view expressed by some that displacement of the womb may cause the anus to become fissured. An irritable ulcer above or encroaching on the sphincter is more likely to be caused by such displacement. Straining, or pressure from hard faecal matter, would likely produce a fissure.

#### SYMPTOMS AND DIAGNOSIS.

Patients who have fissure of the anus will give the history in about these words: "It makes very little difference so far as pain is concerned, when the bowels move, for I know that in about twenty minutes I am going to suffer. It begins as a sharp, cutting, contracting pain, and increases until it seems unbearable. No position that I can assume does any good, and I have it for from two to six hours, when it gradually wears off, and I feel perfectly easy until my bowels move again." This is a common history, and the affection has by physicians been called many names, the most common of which is "piles." It can be set down as an axiom that, if much pain is suffered by the patient, the disease is not piles, for piles in the quiescent state cause very little if any pain.

A fissure may be a very simple affair, only a slight tear through the mucous membrane, or it may be a very complicated and ugly condition. When due to trauma and treated early it will heal kindly, just as any other fresh wound, but if left alone it will assume the proportions of an ulcer. Fissures may be the result of a constitutional affection, as syphilis, tuberculosis, etc., and cannot be effectually cured until constitutional treatment is afforded. The latter are ugly in character, often deep and ragged, and require more surgery than is necessary for the other kinds, such as divulsion, etc.

Fissures may be single or multiple, situated dorsally or lateral, rarely in front. They can be seen generally without a speculum, by drawing down and everting the anus. To detect an irritable oval ulcer higher up, a speculum must be used. An internal opening of a fistula may be mistaken for a fissure, for when located within the grasp of the sphincter the pain is very nearly identical; therefore it will often be necessary to use a probe in making a diagnosis. If the same treatment were adopted in such a case as in fissure, the pain would soon return. Nothing should be overlooked in these cases.

#### TREATMENT.

The treatment of fissure is usually described as both palliative and operative. Taking the pathology and the excessive pain into consideration, it would appear plausible to give the patient immediate relief by doing an operation. Yet patients, as a rule, are so averse to any surgery, when anything else can be substituted, that it may be neces-



sary to use palliative measures in cases of fissure. The writer is on record as advocating an operation in nearly every case of fissure, his reason being the rapidity with which a cure is effected in contrast with a long palliative treatment with indefinite results. The palliative treatment consists in keeping the bowels gently moved with an aperient. Any good mineral water, as Apenta Rubinat or Hathorn, will answer the purpose; keeping the parts cleansed with soap and water, and the use of local applications. The best of these is silver nitrate, either in stick or a strong solution, mildly coating the full extent of the fissure. Sulphate of copper used in the same manner will be found serviceable, or in some cases pure carbolic acid. To use any of these it will often be found necessary to employ a small bivalve speculum and to gradually stretch the rectum until the full length of the fissure is seen. For an application to the oval irritable ulcer it is always necessary to use a speculum. An application to this form of ulceration will not generally be sufficient to effect a cure. It will be found necessary to scarify the surface thoroughly, and sometimes to trim the edges. Divulsion, too, is of great importance in order to release the spasm or grip of the sphincter muscle. Besides the remedies which have been mentioned in the palliative treatment of fissure, a number of others less severe in effect are recommended. The following is used by Mr. Allingham:

R. Hydrarg. chlor. mitis,	gr. iv (0.26);
Pulv. opii,	gr. ij (0.13);
Ext. belladonnæ,	gr. ij (0.13);
Ung. sambuci,	ʒj (4.).—M.

Sig. To be applied frequently.

A better one, in the opinion of the writer, is—

R. Cocainæ,	gr. xij (0.78);
Menthol.,	gr. xv (1.);
Hydrarg. chlor. mitis,	gr. xxx (2.);
Vaselini,	ʒj (30.).—M.

Sig. Apply two or three times daily.

Injections, to be used just after the bowels move, will be found serviceable, and the best is: One ounce of olive oil, containing five grains of iodoform and ten drops of laudanum. Good may be accomplished by having the patient take an injection of four or five ounces of linseed oil every morning before the bowels move. The physician can use his own judgment in selecting remedies of this class, which may be equally effective with any mentioned in the books.

**Operation.**—The operative procedure for fissure must be made to fit the case. A recent attack may yield to the simplest of local applications or to the mildest divulsion, while others will require heroic treatment. In children suffering from fissure it will often be sufficient to have the mother or nurse, each morning, anoint the fore finger and gently insert it into the rectum. After a few times it will be noticed that the infant complains less at stool.

Where a fissure has existed for any length of time in the adult, a more severe operation must be done. It consists in a free divulsion of the sphincter, a deep incision through the fissure, and a paring of the edges of the ulcer, or a free scarification of the whole surface. Originally it was thought advisable to *break* the muscle, and many practise that method yet, but such rash treatment will not be advisable in the majority of cases.

It will be found absolutely necessary in operating for fissure or irritable ulcer to administer an anæsthetic, for the pain incident to doing this operation would be unbearable.

After doing any one of the different operations advised it will be found important to watch the patient in regard to diet, regulation of bowels, cleanliness, etc., for some time, in order that a perfect cure be obtained.

### NEURALGIA AND HYSTERIA OF THE RECTUM.

NEURALGIA at best is a vague term, but when applied to the rectum is most difficult of description. There are so many ways in which pain can be referred to the rectum, that it would be a plain duty to trace the cause before coming to the conclusion that such pain was neuralgia. As to the term *hysteria* of the rectum, the writer has grave doubts as to the correctness of the expression. If pain actually exists it is his expressed opinion that it must be due to a local lesion, and if the premise is correct the idea of its being hysterical is dissipated. When it is remembered that the slightest lesion, abrasion, or tear around the rectum will excite great pain and distress, it can be easily understood that many cases of the kind will appear. Then, too, the affection may be so slight that no pathology, as inflammation, etc., is discernible, and hence a diagnosis of hysteria is rapidly jumped at. The simple exposure of the filament of a nerve may be sufficient to cause acute symptoms, and yet the said filament can be detected only with difficulty. It may be possible that if a patient is on the verge of insanity he might complain of pain in his rectum, or anywhere else, which would be only imaginary, and this is given as one of the cases of hysterical rectum.

Whatever may be the nature or cause of the trouble, certain it is that it is a most difficult thing to effect a cure. Patients of this class generally shift from one physician to another, and often to the satisfaction and great relief of the one that is left.

#### SYMPTOMS AND DIAGNOSIS.

The patients suffering with neuralgia of the rectum are rarely able to give well-defined and intelligent symptoms. When asked to locate the pain they hesitate, and frequently contradict themselves. Some, however, complain of a distinct *spot*, and although nothing can be discovered by the physician at the point indicated, the patient will still insist on his declaration that something must be in trouble there. The pain complained of is generally of an acute nature, simulating very much the fissure pain, although not having the distinctive feature of being connected with the act of defæcation. Sometimes the pain is constant, and proves to be a great burden, showing its effect upon the general health of the patient. Vain imaginings take possession of the patient, and the fear is constant with him that the trouble is malignant. Women are most often the subjects of this affection, and prove to be very troublesome patients. All effort at relief oftentimes proves futile, and they become real objects of pity.

The writer is firmly convinced that neuralgia of the rectum is caused, in the vast majority of cases at least, by a pathological change somewhere; that, if it be in the rectum, a filament of nerve is exposed, and if the disease does not emanate in the rectum it is made manifest there through some one of the reflexes. There are many conditions that could cause such manifestations, such as an irritable prostate, stricture of the urethra, a sensitive ovary, a displaced womb, a diseased coccyx, or a spinal irritation. In persons given to the opium-habit will be found a disposition to complain of imaginary pains, and the rectum will not escape their attention.

#### TREATMENT.

If it could be definitely settled that any given case was due to an hysterical disposition, of course all treatment should be directed to an effort to overcome it. But such efforts will, in the main, be found utterly futile. The mind should be diverted by travel, new associations, active business, etc. Good substantial food should be provided, proper hygiene observed, the bowels regulated, and the secretions watched. The local disturbance, going upon the premise that a lesion exists, should be diligently sought for. It may be a simple filament of an exposed nerve, which if found and divided, or cauterized, will heal. If none such can be discovered, then the reflexes should be traced, and the origin may be found in some contiguous organ, as the



uterus, ovaries, urethra, prostate, or possibly the coccyx. If in the latter it should be removed, or if in any one of the others they should receive proper attention.

It will be found often in cases of neuralgia of the rectum that a great amount of mucus is discharged; this is caused principally by reflex disturbance, and not from any real inflammatory condition. It is well, however, to use some mild astringent injection, as lead acetate, boric acid, fluid hydrastis, or pinus canadensis. If the pain is intense, local applications of silver nitrate, carbolic acid, or copper sulphate may be useful.

Although the character of pain would indicate that free division of the sphincter muscle would be indicated, it will be found that it does no good. A much better plan is to divide the muscle by incision.

As internal remedies such agents as arsenic, the bromides, iron, and strychnine are the best. Along with these cod-liver oil, or the hypophosphites will be of benefit.

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### VILLOUS TUMOR OF THE RECTUM.

COMPARATIVELY few villous tumors of the rectum have been reported; indeed thirty would cover the number. The writer has met with two cases in an experience of nineteen years in rectal surgery. The tumor is recognized as a spongy mass with long villous-like groups over its surface, and has a broad stem which attaches it to the wall of the bowel. The tumor may have its origin in any portion of the rectum, but they are usually situated low down, in reach of the finger. In the writer's cases no pedicle could be made out, but, instead, the base was broad and short.

#### SYMPTOMS AND DIAGNOSIS.

A villous tumor of the rectum could be easily mistaken for a mass of hæmorrhoids, as it protrudes during the act of defæcation. A better diagnosis can be made by feeling the mass while in the rectum. Hæmorrhoids cannot be so felt. From polypi they can be diagnosed by the soft spongy feel, instead of the firm and solid appearance of a polyp. Then, again, the great disposition to bleed, and the free discharge of mucus, is nearly characteristic. The question has often been raised whether these growths are not really malignant and would return if removed. As has been stated, the writer has removed two villous tumors of the rectum, and although a number of years have elapsed they have not returned. There is not the gland-involvement and the cachexia in these cases that is found in cancerous growths,

neither is there the loss of flesh that is so characteristic of the latter. There can be no question, however, that a villous growth can and sometimes does undergo cancerous degeneration. Authors have reported their recurrence after removal, and, in a few cases, death from malignant disease.

#### TREATMENT.

There is but one plan of treatment for a villous tumor, viz. removal. It is fair to say that in this modern day of research no one would question the advisability of removing any tumor wherever located, but especially is this true of a growth that in any way resembles malignancy or is likely to become malignant. The best plan of operating for this class of tumors is by double transfixion and cutting away the mass. It has been mentioned by a few writers that villous tumors of the rectum sometimes "shed" themselves, thereby saving an operation, and that the patients have recovered.

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#### PROCTITIS.

THERE can be no question that the rectum is frequently the seat of inflammation. There are many causes that would be conducive to this state: for instance, hardened feces remaining in the pouch of the rectum; foreign bodies in the rectum; continued nerve-irritation; gonorrhœal infection, worms, unnatural intercourse, and trauma. It has not been the observation of the writer that constipation is often an exciting cause, and he holds to the theory that accumulations of feces seldom take place in the rectum.

SYMPTOMS.—The most prominent symptom of proctitis is a sense of heat and weight in the rectum, straining at stool, some tenesmus, a discharge of mucus, sometimes tinged with blood, an uneasy sensation after stool as if the bowels had not been completely evacuated, and an interference with the proper action of the bladder. Upon examination by the speculum, nothing will be discovered but a highly colored and sensitive mucous membrane.

#### TREATMENT.

The patient should be put upon bland nourishment; the bowels moved daily with an aperient water, preceded possibly by a dose of calomel; the secretions of the kidney watched, and sexual intercourse interdicted. The rectum should be washed out daily with copious injections of hot water containing boric acid, and followed by mild astringent washes, as fluid hydrastis, borax-water, or a mild solution of lead-water. Anything stronger than this is scarcely necessary.





## THERAPEUTICS OF THE MALE GENITO-URINARY TRACT.

By WILLIAM T. BELFIELD, M. D.

### INFECTIONS OF THE GENITO-URINARY TRACT IN THE MALE.

THE genito-urinary tract of the male may exhibit a primary infection by the following parasites :

1. The *gonococcus* of Neisser ;
2. The as-yet-undiscovered *agent that induces syphilis* ;
3. The *bacillus tuberculosis* of Koch ;
4. The various bacterial species that cause suppuration—a dozen or more in number, collectively termed the *pyogenic bacteria* or *pus-microbes*.

To the gonococcus- and syphilis-infections all are apparently susceptible ; freedom from either disease is secured only by avoiding the infecting agent. To the tubercle- and pus-infections, on the other hand, all are frequently exposed ; hence freedom from these infections is secured not by avoiding the infecting agents (which is impossible), but by the natural resistance of healthy tissues. In other words—and this is the item of clinical importance—either tuberculosis or suppuration in the genito-urinary organs implies a pre-existing vice of nutrition. Cystitis, prostatitis, and pyelitis (non-gonorrhœal) are results—are secondary, not primary diseases.

### GONOCOCCUS-INFECTION (GONORRHOEA).

THE gonococcus of Neisser, usually reinforced by pus-bacteria as a mixed infection, is the agent in the induction of the severe urethritis known as typical gonorrhœa.

Beginning at the meatus, the extent of the surface invasion varies : in a minority of cases the infection invades only the penile urethra, ceasing at the triangular ligament ; in the majority it extends, during the second or third week, through the membranous and prostatic urethra to the vesical orifice ; in many it passes on through the ejacu-

latory duct to the seminal vesicle and the dilated extremity of the vas deferens (ampulla); and in 5 to 10 per cent. of cases the infection finally, in the third or fourth week, traverses the vas deferens to the epididymis.

Infection of the lymph-stream is usually arrested in the inguinal and pelvic lymph-glands, though frequently resulting in periurethral suppuration and sometimes in peritonitis. Infection of the blood-current takes place fortunately in only 2 or 3 per cent. of cases, usually as the so-called gonorrhœal rheumatism of fibrous and serous structures—joints, tendon-sheaths, bursæ, muscles; sometimes it attacks the endo- and pericardium or meninges—with fatal result.

The urinary channel proper, above its junction with the seminal canal, usually escapes, the infection ceasing at or about the vesico-urethral orifice; occasionally, however, it extends to trigone, ureter, renal pelvis, and even kidney-tubules.

The virulence of the gonococcus, as of other pathogenic bacteria, undoubtedly varies extremely, though evidence to this effect must for obvious reasons be clinical rather than experimental; such evidence consists of observations like the following: A girl of nineteen, married two weeks, to whose virginity at marriage the husband gave convincing testimony, was found to be the subject of a mild gonorrhœa. The husband had had the disease less than a year before his marriage, the discharge ceasing in about six weeks; it reappeared two days after his wedding. Numerous gonococci were found in the pus from the wife, a few in that from the husband. The girl was apparently well a month after marriage, having suffered no discomfort except from an inflamed inguinal gland; the discharge had been but slight.

The persistence of the gonococcus-infection likewise varies extremely. The writer cannot subscribe to the rather prevalent view which, promulgated a quarter of a century ago by Noeggerath, considers such infection practically permanent, either evident or "latent." It cannot be denied that the infection has been known to persist for years: G. E. Brewer reports an instance in which a man infected his bride six years after his own last attack, and Goll has found gonococci in cases two and three years after the infection. But, on the other hand, the complete disappearance of all evidences of infection, including gonococci, within three to six months has been often observed: the writer has assented to the marriage of a patient eight months after the disease began; and Goll failed to find gonococci in 80 per cent. of all cases examined even three months after the infection began. While, therefore, great caution should be exercised, repeated examinations of urinary threads made, and several months permitted to elapse after the apparent disappearance of the gonococcus before the resumption of sexual relations can be authorized by the

physician, yet each individual case must be decided on its own merits. The frequency with which married men who have contracted the infection resume conjugal relations even before the complete disappearance of the discharge, without apparent injury to their wives, supports the belief that gonorrhœa—in the clinical sense at least—does not usually retain great virulence for many weeks after apparent recovery.

The belief that the gonococcus-infection is a serious barrier to a man's future fertility is also contradicted by clinical observation. It is fair to assume that a large percentage of the fathers of the present day who spent their early manhood in cities have at some time contracted the infection. The writer has known a woman to become pregnant within four months of the beginning of the infection in her husband and herself.

*What constitutes gonorrhœa?* The confusion which reigned prior to Neisser's discovery of the gonococcus in 1879, as to the nature of purulent discharges from male and female genitals, was replaced a few years thereafter by the practice of regarding gonococcus-infection and purulent urethritis as synonymous terms. But further observations have proven beyond doubt that gonorrhœa in the clinical sense—that is, purulent urethritis acquired through sexual contact—is more comprehensive than gonococcus-infection; in other words, that the genitals of either sex are the habitat of certain bacteria other than the gonococcus (perhaps also of toxins) which may, when transferred through the sexual relation, occasion a purulent inflammation. And it is further established that purulent urethritis in the male—like purulent salpingitis, metritis, and vulvitis in the female—may occur when no specific bacteria are present and when no sexual contact whatever, according to the best evidence obtainable, has taken place. While it is doubtless true that in 90 per cent. of cases of purulent urethritis in the male the gonococcus-infection, acquired in the usual way, is the cause, yet it may be of vital importance in a particular case to remember the other 10 per cent. of cases which arise without gonococcus-infection, and some of which at least occur without sexual contact. It appears desirable that by general agreement the ancient term "gonorrhœa" should be now defined as "gonococcus-infection" rather than made to include all cases of purulent urethritis which are or are assumed to be acquired by sexual contact; and in this specific sense the word will be used in this article.

*Non-gonorrhœal Urethritis.*—Many accurately observed cases are now recorded in which the pus from a purulent urethritis following upon and apparently due to sexual contact has contained absolutely no gonococci. In some of these, various kinds of bacteria have been found—a diplococcus, a streptococcus, a bacillus; in certain other



instances no bacterial species was found in numbers sufficient to warrant a presumption of causal relation; and in several carefully observed cases no bacteria whatever were discovered.

Finally, many cases of profuse purulent urethritis arise without infection of any sort from without. These are of two categories: first, cases of "auto-infection;" and second, cases in which the urethra becomes inflamed as the result of a local or general vice of nutrition.

*Auto-infection* of the anterior from the deep urethra, an exacerbation of an apparently cured but really uncured gonorrhœa, is exceedingly frequent; and because, following sexual indulgence, it is often considered a real gonorrhœa by patient and physician alike, auto-infection has given rise to many erroneous ideas as to both prognosis and treatment of gonorrhœa. The man who thinks he has had the disease a hundred times and can cure it in a few days, the physician who has a sure cure for gonorrhœa, are alike deceived; for they have failed to distinguish between a fresh gonorrhœal infection from without and an exacerbation of a chronic uncured gonorrhœa. This failure to differentiate between the two arises largely from the general neglect to distinguish *chronic gonorrhœa* from *gleet*; for these terms are usually considered synonymous, and the patient in whom the discharge from the meatus has ceased is considered cured. But the fact is that long after such free discharge has disappeared (showing the subsidence of the inflammation in the anterior urethra), the infection—that is, the gonococcus—may persist in some of the numerous follicles and glands of the posterior genital canal, especially the prostate and seminal vesicles. Sometimes this persistence is indicated by a gumming of the meatus in the morning; sometimes by the presence of pus-threads in the urine; in other cases only a diffuse purulent cloudiness of the urine betrays the infection; and in still other instances its persistence is not revealed until pressure upon the prostate and vesicles by the examiner's finger in the rectum forces pus into the urethra. Such cases of persistent gonorrhœal infection of prostate and vesicles, even without perceptible discharge from the meatus, may within twenty-four hours after sexual indulgence be aggravated into a profuse purulent discharge—that is, an auto-infection of the anterior urethra. This is commonly considered a fresh gonorrhœa; and because it subsides within a few days (as it may under indifferent treatment) the particular injection or nostrum used during those days is credited with the cure of a gonorrhœa.

When, therefore, a patient presents a profuse purulent urethritis following suspicious connection, it should be remembered that the infection of the urethra may have come not from the front, but from the rear, particularly if the patient give a history of a previous infection.

Auto-infection of the anterior urethra independent of the gonococcus is observed especially in elderly men and in those of gouty tendencies; it is preceded by a chronic prostatitis and vesiculitis. A patient of the writer's, seventy-six years old, whose sexual activity had ceased years before, exhibited the clinical picture of gonorrhœa of several weeks' duration, which, however, promptly disappeared after "milking" of the engorged prostate and vesicles.

The differential diagnosis of urethral discharges requires, therefore, careful consideration of both clinical and microscopical evidence. They may be grouped in four classes:

1. *Gonococcus-infection from without*, marked clinically by an incubation of three to seven days (usually) and a severe inflammatory reaction; the microscope shows an abundance of gonococci contained in both pus and epithelial cells.

2. *Gonococcus-infection from within (auto-infection of the anterior from the deep urethra)*, marked clinically by an incubation of six to twenty-four hours in a patient with a history of previous urethritis followed by a slight gleet, gumming of the meatus or pus-threads in the urine; the microscope may show gonococci, though in less numbers than in cases of the former class.

These two categories include over 90 per cent. of all cases of purulent urethritis in the male.

3. *Non-gonorrhœal infection from without*, beginning within two days after exposure, with slight inflammatory reaction; the microscope shows no gonococci but many pus-bacteria.

4. *Non-gonorrhœal infection from within*; this may be an extension to the anterior urethra of an inflammation in prostate and seminal vesicles in elderly men; it may follow injury by urethral instruments or caustic injections; or it may be due to undefined errors of nutrition. No gonococci are visible.

#### TREATMENT.

Efforts to mitigate the gonorrhœal inflammation have heretofore consisted of local applications (injections), and of the internal administration of substances like the balsams, which, being eliminated by the kidneys, irrigate the inflamed surfaces during urination. All such measures are at best but palliative; the anatomical reasons are alone sufficient to explain the futility of all surface medication. For the urethra is dotted with numerous lacunæ, half of them opening backward, into which no injection nor urinated fluid can be expected to enter; while Cowper's glands, the prostatic follicles, the utricle, and seminal vesicles, into all of which the infection may and often does extend, are evidently beyond the reach of urethral medication; moreover, the gonococci may penetrate the subepithelial tissue.

The rational treatment of gonorrhœa—the destruction of the invading bacteria, or at least the inhibition of their growth—must evidently be accomplished by way of the blood-current; for this is the one medium by which the entire infected surface, its nooks and crannies, lacunæ and follicles included, can be reached. Unfortunately, the remedy capable of accomplishing this result is still undiscovered; hence treatment of this infection is palliative.

The treatment of anterior urethritis may be thus summarized: The patient should be instructed to scrupulously avoid constipation, bodily activity, alcohol, and sexual excitement, and to limit his indulgence in meats, coffee, and tobacco; he should destroy or sterilize by boiling any cloths or handkerchiefs soiled by the discharge and, to protect his own eyes, should wash his hands immediately after every contact with the infected parts or dressings; he should protect his linen, not by inserting cotton under the foreskin (because the pus is thereby retained in the urethra and spread over the glans), but by wearing a gonorrhœa-bag or similar article which, without compression of the penis, permits the escape of pus into the receptacle.

Internal medication consists of laxatives; the value of *copaiba*, *cubebs*, and sandalwood oil is diminished by the irritation of stomach and kidneys produced by them. Local treatment consists of frequent immersion of the penis in hot water, and in the injection of one of the following solutions:

R. Yellow muriate of hydrastia,	8 gr. ;
Water,	8 oz.
R. Protargol,	8 to 20 gr. ;
Water,	8 oz.
R. Zinc chloride,	8 gr. ;
Zinc iodide,	16 gr. ;
Water,	6 oz.
R. Yellow muriate of hydrastia,	8 gr. ;
Protargol,	16 gr. ;
Water,	8 oz.

When it is necessary to avoid possible stains, the liquid colorless hydrastis may be substituted for the yellow compound.

R. Protargol,	16 gr. ;
Colorless hydrastis,	3 oz. ;
Water,	5 oz.



Injections should be made with a hard-rubber syringe holding half an ounce and terminating in a blunt tip without nozzle; and it is wise for the physician to instruct the patient how to inject, both verbally and by administering an injection and by causing the patient to repeat the process in the doctor's presence.

Within ten days after the discharge has begun the infection usually invades the prostatic urethra, such invasion being indicated by pain in the glans penis, increased frequency of urination, and a sense of weight in the perineum. Medication must now be extended to the deep urethra, as follows: a syringe holding at least one ounce is filled with one of the solutions above mentioned, which is gently injected; when about half an ounce has been injected, distinct resistance—due to the cut-off muscle (the membranous urethra)—is encountered. The patient should now make a strong effort to urinate, meanwhile maintaining pressure on the piston of the syringe. Usually at the first or second attempt the entire contents of the syringe pass into the penis, bathing the entire urethra from meatus to bladder. All subsequent injections should be thus made. In exceptional cases the patient is unable to inject past the cut-off muscle while standing erect; yet he may succeed in the crouching posture (as in defecation), or when lying on his back. In rare instances he will be unable to inject the deep urethra except through a soft-rubber catheter.

Under such treatment the discharge becomes slight and watery within a few days; nevertheless the disease is not eradicated, and the treatment should be continued for a month or more. It should be impressed upon the patient that the cessation of free discharge from the meatus does not prove that he has recovered; for long after this stoppage of the flow there may persist various evidences of disease, such as a gumming together of the meatus especially during the night, the appearance of a milky drop in the morning, and the constant presence in the urine of thick white threads of pus (*Tripper-fäden*), which soon sink to the bottom of the vessel. The persistence of any of these phenomena indicates the presence of one or more infected areas in the genital canal, and the case must be considered one of chronic gonorrhœa.

#### CHRONIC GONORRHOEA; GLEET.

It has been customary to consider chronic gonorrhœa and gleet synonymous terms—an erroneous conception, for by a gleet we understand a discharge from the meatus, while the gonorrhœal infection often persists in the prostatic urethra and seminal vesicles long after the anterior urethra is practically well and free discharge has ceased.

Hence a chronic gonorrhœa may long exist without a gleet—an important clinical distinction. Gleet is the continuation of a discharge from the meatus and may vary from a profuse milky to a slight watery flow; during the day there may be no distinct discharge but only a gumming of the meatus; in the morning a drop or two of milky fluid can be expressed. While the discharge proceeds directly from the anterior urethra, its source may lie in the prostate or seminal vesicles; failure to recognize this fact is the explanation of many failures to stop the discharge: the patient uses one drug after another, one injection after another, with only temporary relief.

The first step toward the intelligent treatment of gleet is therefore the discovery of the infected area, which may be found anywhere from the meatus to the vas deferens. For practical diagnosis and treatment the possible sources of a gleety discharge may be divided into three groups: 1. Anterior urethra (to the bulbo-membranous junction); 2. Deep urethra (from bulb to bladder, including the membranous and prostatic urethra and utricle); and 3. Prostate, seminal vesicles, and ampullæ.

The simplest means for determining which of these three portions is the source of the gleet is called the "three-glass test," which is thus made: The patient, having retained his urine for two hours or more, submits to a thorough irrigation of the anterior urethra; he then passes about an ounce of urine into the first glass, whereby the pus is washed from the deep urethra; the physician's finger (enclosed in a rubber condom) is then introduced into the rectum and gently presses the prostate and seminal vesicles; the patient then passes another ounce of urine into the second vessel and the remainder into the third. A comparison of the amount of pus in the respective glasses affords a fair inference as to its source. It is chiefly important to know whether the pus-production is limited to the anterior urethra or extends also to the deep urethra; in the latter case some involvement of the prostate and seminal vesicles may be expected.

Digital examination *per rectum* should never be neglected in determining the source of a gleety discharge, even though the anterior urethra is found to be strictured or otherwise diseased; for the prostate and seminal vesicles are often the seat of persistent infection and contribute to or even originate the discharge.

#### TREATMENT OF CHRONIC GONORRHOEA AND GLEET.

The first step is a determination of the seat of the diseased area, as already outlined; a routine prescription of injections or use of sounds, while curing a certain number, will fail to relieve many that are amenable to intelligent treatment.



Certain general measures are applicable to all cases. They should carefully avoid constipation, alcohol, and the excessive use of tobacco and coffee. The special measures that may be required are—1. Sounds; 2. Injections, anterior and deep; 3. "Milking" of the prostate and seminal vesicles; 4. Medicines; and (occasionally) 5. Local applications to diseased patches through the endoscope.

1. SOUNDS.—A stricture should be treated by gradual dilatation carried to the full calibre of the urethra (No. 32 to 36 French). If a narrow meatus prevents the use of large sounds, the surgeon should choose between enlargement of the meatus (which is advisable in exceptional cases only, when the calibre is less than No. 20 French) and dilatation by means of special instruments, the dilators of Otis, Tuttle, and Oberländer.

2. INJECTIONS.—Of the multitude of injections recommended for gleet of the anterior urethra the following are useful: hot water (as hot as can be borne), alone, and containing in solution yellow hydrastis muriate (saturated) or picric acid, zinc permanganate, nitrate of silver, 1 grain to 8 ounces.

*Deep Injections.*—Liquids injected from the meatus do not ordinarily reach the deep urethra because arrested by the so-called "cut-off" muscle, that is the membranous urethra; medication for the deep urethra is therefore usually made through a tube introduced beyond the bulb. Special syringes for this purpose have been designed by Guyon, Keyes, and others, whereby an exact number of minims of a given strong solution can be deposited in the deep urethra, a process often called "instillation." A better practice is irrigation of the deep urethra with a larger quantity of a weaker solution; for this purpose a small soft catheter (sterilized) is introduced until the urine flows, then withdrawn about an inch and a half; a five-ounce rubber syringe or small fountain syringe (hung low) is then attached. The solution passes from the catheter into the deep urethra and thence into the bladder, the cut-off muscle preventing its escape anteriorly; the catheter is then withdrawn and the patient empties the bladder, thus passing the solution a second time over the deep urethra. The solutions used may be nitrate of silver (1 part to 5000 of water); bichloride of mercury (1 part to 10,000); potassium permanganate (1 to 5000). Many patients can with practice inject the bladder without a catheter by the method already described; liquids gently injected by means of an Ultzmann five-ounce syringe may, after slight delay at the cut-off muscle, flow into the bladder: elderly men are especially favorable subjects for this method. The method of irrigation with weak permanganate solution (commonly called Janet's method) is sometimes of service in the treatment of chronic gonorrhœa; it seems, however, to be accompanied by unusually frequent extension of the



infection to the sexual canal proper—i. e., the vas deferens, seminal vesicle, and epididymis.

3. MILKING THE PROSTATE AND SEMINAL VESICLES is always required when these parts are obviously diseased, and is sometimes useful even when no morbid condition is detected. This manipulation is thus performed: The physician's forefinger, enclosed in a rubber condom which should be anointed with glycerin, is gently introduced into the rectum, the patient either lying on the back or standing with body bent forward; the seminal vesicle being identified on one side of the rectum, the tip of the finger is drawn gently along it toward the prostate; this manœuvre is repeated six or eight times, after which the other vesicle can be, if necessary, similarly treated. The finger then being partly withdrawn, its tip is made to stroke the prostate toward the anus in a similar gentle manner; the prostatic utricle, which lies between the lateral lobes of the organ and is often distended with pus, should be included in this stroking process. During this manipulation and immediately afterward a purulent fluid may be discharged from the meatus. This milking process should always be performed with great care and gentleness; for the prostate, particularly when the subject of chronic inflammation, is exceedingly sensitive, and the operation at first very painful, often inducing faintness on the part of the patient (for this latter reason the recumbent is preferable to the standing posture for the patient). The process should not be repeated oftener than once in three or four days; greater frequency or undue pressure with the finger sometimes provokes an extension of the inflammation to the epididymis.

4. MEDICINES administered by the mouth cannot be relied upon to influence a gleet: some effect may be obtained from thyroid powder in 2- or 3-grain doses three times a day, or turpentine oil or tincture of cantharides in 3-drop doses. Iron and other tonics are beneficial to a patient showing signs of anæmia; mercury and iodine when syphilis is admitted or probable; guaiacol in tuberculous subjects; in malarial districts quinine may have a decided effect in checking gleet.

5. LOCAL APPLICATIONS to diseased areas through the urethroscope are sometimes necessary: the diseased surface is brought into the field, cleansed with cotton, and touched with a stick of copper sulphate, or a solution of silver nitrate or of chromic acid (5 to 20 per cent.), the application being repeated every few days as the course of events indicates.

## SYPHILIS.

THE chancre occurs within the urethra more frequently than is generally stated; doubtless the slight purulent discharge which it occasions is usually mistaken for a mild gonorrhœa. The reprehensible but extensive practice of widely incising the meatus—so prevalent in the past few years in the search for strictures of large calibre—has doubtless favored urethral infection with syphilis as well as with gonorrhœa. The writer has seen urethral chancre followed by the usual constitutional symptoms in two brothers in each of whom the meatus had been widely divided.

Constitutional syphilis is seen in the urethra, penis, kidney, scrotum, and testicle. In the urethra it may cause a slight purulent discharge which is said to proceed from mucous patches similar to those commonly observed in the mouth; this has perhaps sometimes been treated locally and unsuccessfully as a gleet; it yields readily to internal treatment for syphilis. Every subject of an obstinate gleet should be interrogated as to previous syphilis.

In the penis gummata occur in the cavernous bodies, in the furrow between them, and in the glans; distinct nodules in these localities should always arouse a suspicion of syphilis and lead to specific treatment; an ulcerating gumma of the glans must not be mistaken for epithelioma.

There have been reported a few cases of gumma of the kidney simulating tuberculosis of that organ; in two such nephrectomy was made, and the diagnosis corrected by examination of the specimen. The differential diagnosis must rest upon the absence of tubercle bacilli from the urine and upon the effects of syphilitic treatment.

In the scrotum syphilis often appears as broad condylomata, usually associated with similar growths at the anal margin or behind the corona glandis; their appearance is characteristic.

The testicle is frequently the seat of gummata which are liable to be mistaken for other neoplasms. The syphilitic testicle is smooth, globular, and painless—characteristics by which it is distinguished from most other enlargements. In general, every doubtful tumor of the testicle should be subjected to the internal administration of mercury and iodine as well as to mercurial inunction locally.

## TUBERCULOSIS.

THE tubercle bacillus causes a frequent and clinically important primary infection of the genito-urinary organs, aside from the numer-

ous cases of secondary infection of those organs from primary disease of the lungs.

By primary tuberculosis is meant the earliest perceptible tuberculous focus; it is probable that infection of the bronchial glands or other inaccessible parts usually precedes the appearance of the disease in the genito-urinary tract. Primary tuberculosis of these organs is usually first seen in the epididymis and the ejaculatory duct, less commonly in the kidney; but it rarely remains long limited to these organs, the prostate and seminal vesicle usually exhibiting the infection when the patient is first seen. While it must be admitted that the foetus at birth may contain tubercle bacilli, yet opportunities for infection after birth are so numerous that post-natal infection seems the more plausible. It is probable that infection of the genito-urinary organs in the male is always by one route, the blood-current, whereby the bacilli are brought from old foci in the cervical and bronchial glands, in lungs, joints, or intestines; the idea that intercourse with a subject of tuberculosis of the pelvic organs can cause the ascent of tubercle bacilli along the male urethra to the prostate is fanciful and entirely devoid of proof.

The liability of the genito-urinary tract to active tuberculosis begins with puberty and is greatest during the succeeding ten or fifteen years; although tuberculous nodules have been demonstrated in the epididymis in children prior to puberty, and in the genital organs of elderly men, yet nearly all cases of genito-urinary tuberculosis first attract attention between the ages of fifteen and thirty years. Yet since the disease rarely causes pain until the mucous surface of the prostate or bladder is invaded, it may exist for years in the other organs without compelling the patient to seek medical advice.

The lodgment and development of the tubercle bacilli are favored by that ill-defined vice of nutrition that we term hereditary predisposition, by injury, and possibly by gonorrhœal epididymitis; but it must be remembered that genito-urinary tuberculosis may be found in robust, athletic subjects in whose history none of these predisposing factors can be traced—a fact of clinical importance, because we are disposed to associate the idea of tuberculosis with marked cachexia.

The *symptoms* of genito-urinary tuberculosis vary with the site of the infection; in general it may be said that subjective symptoms are slight or absent until the mucous surface of the prostate is involved or until blocking of the ureter occurs. This usual absence of pain and vesical irritation accounts for the frequent failure to seek medical advice until the infection has become quite extensive. The primary focus is found usually in the epididymis, less frequently in the kidney.



In the epididymis there can be detected hard nodules, at first small and slowly enlarging until by their coalescence much or all of the epididymis is converted into a hard, painless mass continuing into and finally involving the spermatic cord; the testicle remains long unaffected, but is finally transformed into a similar mass; sometimes one or more nodules soften at an early stage, the skin is perforated, and a persistent fistula remains. Soon after the infection is established in the epididymis it is transmitted to the seminal vesicle and prostate, in which organs the examining finger in the rectum detects distinct hard nodules; extension to the mucous surface causes the symptoms of "cystitis"—pus in the urine and vesical irritability.

Renal tuberculosis may long exist without symptoms other than pyuria, although vesical irritation may occur early. Usually there are no symptoms directing attention to the lumbar region unless the ureter becomes blocked with pus or new tissue; then mild renal colic ensues. This absence of local symptoms is very deceptive; the writer once opened a tuberculous kidney to relieve renal colic due to obstruction; at the patient's death from uræmia ten days later, the opposite kidney—which had never given any symptoms whatever—was found to be a mere sac of tuberculous pus. In another case a patient suffered from severe cystitis with occasional slight renal colic; drainage of the affected kidney completely and immediately relieved the cystitis.

The presence in the pus of tubercle bacilli (which must be carefully distinguished from smegma bacilli) constitutes positive evidence of the nature of the disease; but failure to find them is so common that the physician should depend largely upon the other diagnostic signs. Since tuberculosis seldom occurs in any of the genital or urinary organs of the male without soon involving the prostate, a digital examination *per rectum* is in the writer's experience the most important diagnostic measure. The cystoscope is useful in determining whether the pus depends from one or both kidneys as well as in discovering tuberculous lesions in the bladder; but it is essential to the diagnosis in comparatively few cases—fortunately, because the irritability of the bladder is usually so great as to render cystoscopic examination very unsatisfactory even with anæsthesia.

#### TREATMENT.

Experience has shown that the attempt to cure tuberculosis of the genito-urinary tract by surgery is rarely successful, simply because the aid of the surgeon is seldom sought until the infection has attacked numerous and inaccessible sites. While it is true that in exceptional cases the excision of a tuberculous testicle or kidney, even the resection of the bladder, has effected an apparent cure, yet in general surgical measures are useful merely in removing debris of tissue from the

accessible parts—epididymis, testicle, and kidney ; the surgery of this infection, at least in the urinary organs, should aim to be palliative, not radical.

Fortunately, medicinal measures are often successful in at least arresting, even in apparently curing, the disease. Such apparent cures are doubtless merely a repression of the infection, for actual extermination of the parasite probably never occurs ; the tuberculous, like the syphilitic, infection seems by our present means incurable.

Dry air, sunshine, exercise, good food, and active excretion are exceedingly important ; strychnine, arsenic, and guaiacol are scarcely less necessary. The two drugs first named should be given internally in full doses ; 15 minims of guaiacol, mixed with three times as much glycerin or olive oil, should be applied locally to the epididymis and cord, over the bladder or kidney, according to the part affected, two or three times daily ; as repeated applications to the same spot cause tenderness and desquamation, the site should be changed daily. To avoid the odor inseparable from the external use of guaiacol, the drug may be given by the mouth, 10 or 12 drops being taken after each meal in cream, milk, wine, or on a lump of sugar ; or the benzoate of guaiacol may be taken in capsules, 10 grains after each meal. Under this treatment the writer has seen cases of extensive, almost hopeless, genito-urinary tuberculosis symptomatically cured without change of climate, and so remain for periods up to five years.

Extension of the infection to the mucous surface of the bladder-neck renders urination very frequent and exceedingly painful ; in this condition nuclein solution, prepared by Vaughan's formula and injected into the bladder (1 drachm to the ounce of warm water) mitigates the vesical pain and tenesmus more effectually than do opiates.

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### PYOGENIC INFECTIONS (CYSTITIS, PYELITIS).

THE urinary channels are peculiarly exposed to the entrance of bacteria by way of the blood-current, the urethra, and the rectum. Yet it seems that septic infection of the normal urinary tract does not occur ; in other words, that suppuration in this tract is preceded by some impairment of nutrition whereby the natural tissue-resistance is depressed. Many examinations have demonstrated that the normal urinary tract from kidney to prostate is absolutely sterile ; and, though the normal urethral surface is known to harbor pus-bacteria, yet they fail to enter its tissues until these have been disturbed by some other agency. When this natural vitality of tissue is lowered by the stagnation of urine and venous congestion resulting from a tight stricture or pro-

static enlargement, by the growth of the gonococcus, by a calculus or tumor, then the pus-bacteria—which easily gain access by one of the routes mentioned—may quickly infect a part or the whole of the urinary tract.

In cases of cystitis and pyelitis, therefore, a most important item of treatment is the discovery of the cause—that is, of the local failure of nutrition which renders the tissue unable to resist the pus-bacteria. This cause may be found as an obstruction to the exit of urine or foreign body in the bladder, or it may be a general vice of nutrition such as accompanies gout or spinal disease; sometimes the primary lesion is outside of the urinary tract—a seminal vesiculitis, an appendiceal or perirectal inflammation, etc. Whatever it be, a careful examination of the urinary and pelvic organs should precede the treatment of prostatitis, cystitis, or pyelitis.

#### TREATMENT.

The discovery and removal of the cause is the first and often the only necessity in treatment. If for any reason this cannot be done, treatment can only be empirical and palliative, and is often unsuccessful.

The vitality of the tissues is to be increased by hygienic measures, by careful attention to the excretory functions, and by strychnine and guaiacol internally; the so-called urinary antiseptics, especially salol and boric acid, may be given with large quantities of water, and the bladder irrigated daily with a weak solution of silver nitrate (1:5000), which the patient should expel after the catheter is withdrawn, thus bringing the solution in contact with the bladder-neck. The tincture of cantharides, 1 to 3 minims three times daily, is an empirical remedy often of great value in relieving vesical irritation, though it is impossible to predict in what cases it will succeed. Urotropin, which was placed upon the market about three years ago, has already secured general recognition as the best means in our possession for combating infections of the urinary tract by all bacteria except the gonococcus and tubercle bacillus. It should be given in 5- to 10-grain doses after each meal and at bedtime, in capsule or dissolved in water. Compressed tablets containing  $7\frac{1}{2}$  grains each are now procurable; four of these make an average daily quantity. This remedy may be administered for weeks without harm, though benefit is usually apparent within three days. Cystogen and aminoform are said to be identical in composition and effect with urotropin, and are less expensive.



### LOCAL DISEASES OF THE MALE GENITO-URINARY TRACT.—URETHRAL DISEASES.

STRICTURES of the urethra are portions of the canal whose dilatability is less than normal; they have usually been classified as spasmodic and organic. While a "spasmodic" stricture—a narrowing of the channel due to spasmodic contraction of the muscular fibres encircling it—is doubtless possible, at least in the membranous portion, the obstruction often met at the bulbo-membranous junction and ascribed to spasm is frequently due to unskilful handling of the instrument: this is not made to follow the natural curve of the urethra and hence strikes against the firm triangular ligament just behind the bulb. The more skilful in catheterism the surgeon becomes, the less frequently he discovers "spasmodic" stricture.

Organic stricture—a diminution of the normal distensibility of this canal by an overgrowth of the submucous connective tissue—was formerly always ascribed to either gonorrhœa or trauma; but it is now known that strictures exist, especially in the anterior half of the urethra, in men who have never had gonorrhœa; some of these at least are congenital and due to the incomplete absorption of the connective-tissue partition which in early foetal life separates the penile from the glandular urethra.

Organic strictures may be present at any time of life, but are most frequently detected between the ages of twenty-five and forty-five. Strictures are far less troublesome in late than in middle life, possibly from the proneness of the cicatricial tissue composing them to undergo fatty degeneration.

The brilliant work of Otis in proving that the distensibility of the normal urethra is much greater (Nos. 30 to 35 of the French scale) than was formerly supposed, led to the attachment of undue importance to alleged "strictures of large calibre" and to a rather liberal practice of internal urethrotomy for their relief. Later experience has shown that the distensibility of the normal urethra varies greatly in different parts of this canal; that many of the so-called strictures of large calibre are normal structures; and that their division by the knife fails to cure many disorders that were formerly ascribed to them.

In every case of gleet or of disordered micturition, examination of the distensibility of the urethra should be made; indeed, such examinations should be a routine part of the investigation of almost every case of chronic urinary or genital disorder. Narrowing of the urethral canal may be detected by bulbous sounds when the meatus is sufficiently large to permit their introduction; when this orifice is abnormally small (less than No. 22 French) the physician should use a

pecially constructed dilating bulb, the urethrometer, which can be introduced closed through the narrow meatus and expanded within the canal; division of the meatus is seldom justified. Bulbous sounds should not be introduced into the membranous urethra; this portion of the canal is explored by the ordinary conical sounds.

#### TREATMENT OF STRICTURES.

The restoration of the urethral distensibility is the theoretical object of treatment; but it should be understood that by all methods heretofore employed such restoration is incomplete and transient; for while the symptoms can be abolished, yet an anatomical cure is probably unknown—recurrence of the contraction is to be expected. Hence a young patient with a stricture should be informed that even after apparent cure the contraction is apt to recur in a few years and need a repetition of the treatment; and that such recurrences will probably continue until he has passed the age of fifty-five years. There are two principal methods of treatment of urethral stricture—gradual dilatation and incision (urethrotomy). Gradual dilatation is the ideal treatment, successful in most cases of non-traumatic stricture; it often fails in two classes: 1. Traumatic strictures of the perineal urethra; and 2. Strictures of the glandular urethra—that is, within half an inch of the meatus. The value of gradual dilatation consists not in a direct spreading of the narrow portion, but in the fact that this stretching is followed by a decided congestion of the stretched portion, whose subsidence includes the absorption of some of the fibrous tissue constituting the stricture. The repetition of this process, not oftener than every three or four days, by the successive introduction of conical sounds of gradually increasing size, causes ultimately a more or less complete removal of the strictured tissue.

Urethrotomy, formerly much employed, is now generally reserved for cases in which dilatation is ineffectual because of the extreme hardness or extent of the stricture-tissue. Internal urethrotomy should be restricted to strictures within a half-inch of the meatus; elsewhere the operation is dangerous, the mortality being at least 2 per cent.; and there is great chance of severe hæmorrhage and of urinary infiltration, followed by local abscess, general septic infection, and such destruction of cavernous tissue as to induce, after recovery, a pronounced curvature of the penis when erect.

If an old stricture of the penile urethra be found undilatable, a combined operation—internal urethrotomy and external perineal urethrotomy—should be made; the urine is thus prevented from entering the wound in the penile urethra because drained out through the perineal tube, and the dangers of urinary infiltration are thus avoided.



Undilatable strictures of the membranous urethra should be treated only by external urethrotomy.

*Electrolysis.*—The effect of a negative current of 8 or 10 milliampères for ten minutes at intervals of three or four days has found some advocates: after much experience the writer considers this method much inferior to dilatation, except in cases of almost impermeable strictures, in which it has repeatedly rendered him valuable service.

Thiosinamin,  $\frac{1}{4}$  to  $\frac{1}{2}$  grain dissolved in water, three times daily, is a valuable aid in the absorption of cicatricial tissue in the urethra as elsewhere: after considerable experience with it the writer considers its use for several months an essential in the satisfactory treatment of hard strictures.

**TIGHT AND IMPERMEABLE STRICTURES.**—Through the patient's neglect to seek assistance a stricture may so contract as to almost obliterate the urethral canal, permitting the passage of urine only in a very fine stream or even by drops, and causing distention of the bladder. If the subject of such a stricture becomes chilled, or indulges excessively in alcohol, he may suddenly find himself completely unable to void urine. Such strictures are usually amenable to gradual dilatation provided an instrument can be made to pass the narrow portion; this attempt should be made with "whip bougies," which are filiform for several inches of their length and then gradually increase in size to No. 12 or No. 15 of the French scale. When called upon to treat a stricture impermeable to ordinary bougies, especially if there be sudden and complete retention, the surgeon should apply hot water freely to the pelvic region, both externally by baths or fomentations and internally by rectal injections. Olive or castor oil is injected into the urethra and retained by closing the meatus; a whip bougie is gently introduced, the penis being drawn taut so as to obliterate transverse folds of the urethra; the filiform end is gently advanced to the stricture and the minute opening is sought. Sometimes success is immediate; more often repeated trials continued for many minutes are necessary; only gentle pressure should be made, since undue violence may result in puncturing the urethra (making a false passage) or in doubling the filiform end. If the instrument finally enters the stricture it should be passed on until its expanded portion has been forced into or through the stricture, thus enlarging the contracted part at once to a size which will permit the passage of a small bougie. The patient should be warned that the urinary stream may become very small a few hours later, and should be instructed to sit in hot water should he have difficulty in expelling his urine. If all efforts to pass the stricture fail, another attempt may be made on the following day; if the bladder be much



distended it should be relieved by suprapubic aspiration—a measure which frequently facilitates the subsequent passage of the stricture, because it favors the subsidence of urethral œdema. In exceptional cases repeated efforts having failed to open a passage through the urethra, the surgeon must open this canal through the perineum or enter it through a suprapubic cystotomy, in either case catheterizing the urethra from the rear. When the meatus is unduly small, strictures may be stretched by means of special instruments constructed on the umbrella principle and called urethral dilators.

The barbarous and dangerous method of rupturing a stricture, formerly in vogue under the name of “divulsion,” should never under any circumstances be employed.

The treatment of stricture may be thus summarized: Gradual dilation is the preferred and usually successful method; internal urethrotomy is often necessary in tight strictures within half an inch of the meatus, and external urethrotomy in tight strictures, especially traumatic, of the membranous urethra; very tight strictures should be rapidly dilated by the whip bougie; intractable strictures of the penile urethra may require combined internal and perineal urethrotomy. The prolonged use of thiosinamin is a valuable adjuvant in promoting the absorption of stricture-tissue.

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### URINARY FEVER.

THE use of instruments in the urethra and bladder, especially when these organs are inflamed, is often followed by chills and high fever—phenomena variously termed urethral, catheter, or urinary fever. These unpleasant symptoms most frequently follow lacerations of the mucous membrane, but can occur when no such laceration is apparent. The clinical course of urinary fever is variable: sometimes all morbid phenomena disappear in a day; sometimes they last for several days; and in some cases, especially in elderly patients, the fever assumes a typhoid aspect and continues until the patient's death some weeks later.

The term “urinary fever” designates several distinct morbid conditions. These are—

- (1) Intoxication through lacerations of the mucous membrane with poisonous substances from the urine or from the mucous surface;
- (2) Infection of the blood-current with septic bacteria through such laceration;
- (3) Infection of the urinary channels—bladder, ureter, and kidney—with septic bacteria, constituting a suppurative cystitis;

(4) Acute congestion of the entire urinary tract following the change in pressure caused by the sudden withdrawal of the urine in cases of chronically distended bladders; this condition is usually indicated by hæmaturia; and

(5) (Probably) a reflex nervous action.

The *avoidance* of urinary fever should be attempted by—

1. Gentleness of all instrumental manipulation, whereby the chance of lacerating the mucous membrane is diminished.

2. Careful irrigation, through a soft catheter, of urethra and bladder before metal instruments are introduced; and

3. In cases of chronically distended bladders, such as accompany prostatic enlargement and tight strictures, the physician should be careful, when called upon to introduce the catheter for acute retention or other cause, never to evacuate the bladder completely at the first sitting; a portion only of the urine should be withdrawn, and the bladder gradually emptied by repeated catheterism during several days.

4. Urinary antiseptics, foremost among which is urotropin, may be administered for a few days before and after urethral instrumentation.

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### PROSTATE AND APPENDAGES.

THE prostate, its utricle, the seminal vesicles, and the dilated extremities of the vasa deferentia (called ampullæ) are, like the uterus and tubes of the female, enclosed in a thin fibro-muscular sheath which I have called the "broad ligament of the male." Infections and suppurative processes usually extend from the prostate to the seminal tubes and often to the enclosing fibrous sheath; hence we may, for brevity's sake, speak of the diseases which affect the prostate, utricle, and vesicles collectively as affections of the "prostate and appendages."

Acute inflammation of these organs is caused usually by the gonococcus-infection, occasionally by the internal administration of cantharides, capsicum, or other irritant, possibly by gout.

The chronic infections are gonorrhœal, tuberculous, and septic.

The chronic septic infections of the prostate and seminal tubes, when not gonorrhœal, are caused by urethral instrumentation, caustic urethral injections, by extension of a chronic urethritis due to tight stricture of the deep urethra, by extension from a cystitis, by prostatic calculi, and by horseback and bicycle riding. They are favored by the chronic venous congestion of the pelvic organs which is so common

in middle and advanced life as the result of constipation, alcohol-drinking, high living, lack of exercise, and excessive sexual indulgence.

The symptoms are dull pain in the suprapubic region, rectum, perineum, and sometimes in the glans penis, often aggravated by jolting or sitting on upholstered chairs; there is often pain in the sacral region (which the patient usually ascribes to his kidneys). Urination may be unduly frequent and be followed by the escape of a viscid grayish or watery fluid (from the prostatic glands) which the patient considers semen; sometimes there is a continuous slight discharge of similar fluid from the meatus—"prostatorrhœa;" sexual desire may be decreased and the normal sensation diminished or even absent; ejaculation may be premature and erection feeble; the patient is often extremely despondent. This is really the condition of incipient impotence, leading ultimately to loss of virility; indeed, until questioned, the patient may complain of the sexual symptoms only.

Examination with the forefinger (enclosed in a rubber condom) reveals a sensitive and swollen condition of the prostate or vesicles, or both; gentle milking of these parts causes the appearance at the meatus of considerable fluid.

The TREATMENT should begin with the removal of the cause of the trouble when this is practicable, such as the dilatation of a stricture. The local measures directed especially to the prostate and appendages have been already described in the discussion of Chronic Gonorrhœa. The despondency of the patient should not be ignored nor ridiculed; a cheerful prognosis and tonics are useful.

#### ENLARGEMENT (HYPERTROPHY) OF THE PROSTATE.

The frequent condition so-called includes three anatomical states: 1. A diffuse enlargement of the prostate; 2. Localized tumors of its glandular and muscular tissues, which project into the bladder; and 3. Degeneration of the prostatic sphincter (vesical orifice), whereby the dilatability of this orifice is impaired or lost. The diffuse enlargement is certainly often the result of the process just described—chronic inflammation of the prostate and vesicles; the local tumors may result from and accompany this inflammatory condition, or may arise as do tumor-formations in general. They are found in many cases of enlarged prostate, though their presence cannot usually be recognized until the bladder is opened, because they grow into the vesical cavity and cause no change in the rectal surface of the gland, which alone is accessible to the examining finger; they can sometimes be seen through the cystoscope.

Prostatic enlargement is a disease of the second half of life; it often begins before the patient becomes fifty years old, but does not usually cause him to seek a physician's advice until several years



have elapsed; indeed, the derangement of the urinary function is so gradual that the patient often ignores it until some pronounced symptom of advanced disease, such as complete retention of urine, startles him.

A patient over forty-five years of age who complains of any urinary derangement should be examined *per rectum*; undue size of the prostate should lead to the passage of a clean soft catheter immediately after urination; a flow of residual urine (which should be stopped at a few ounces) shows that the voluntary evacuation of the bladder is incomplete and that the familiar train of distressing phenomena incident to advanced prostatic disease threatens the patient.

The examiner must now exclude other morbid conditions which may give rise to the symptoms of cystitis, prominent among which are vesical calculus, tumor, tuberculosis, and prostatic cancer. Calculus can generally be recognized by the sound, tumor by the cystoscope, tuberculosis by the nodular thickening in the seminal vesicles, prostate, and epididymis; and prostatic cancer by the uneven, nodular hardness of the prostate, the enlargement of inguinal lymph-glands, hæmaturia, and emaciation of the patient. It should be remembered that the chronic retention of urine resulting from prostatic enlargement favors the formation of vesical calculus, which is an exceedingly common—and often overlooked—sequence of this condition.

#### TREATMENT OF PROSTATIC ENLARGEMENT.

The treatment is general and local; personal hygiene, including good digestion, regular and easy defecation, warm clothing, exercise, avoidance of cold and of excesses in eating and drinking, is very important; the patient should drink three pints or more of pure water daily; in cases where marked hardness of the prostate indicates fibrous tissue, thiosinamin—half a grain in water after each meal, continued for weeks—is a valuable remedy.

Local treatment endeavors to reduce the congestion and œdema of the prostate; to promote evacuation of the bladder; and to prevent or arrest septic infection of the urinary passages. To this end there are three principal means—the milking of the prostate and vesicles by the finger in the rectum, previously described; the free use of hot water as baths, irrigations of the bladder, and rectal enemata; and the passage of a large sound once a week. If septic infection of the bladder-neck, shown by pus in the urine, already exist, the prostate and bladder should be irrigated with a weak solution of silver nitrate (1:5000); and urotropin, 30 grains daily, should be administered.

In the later stages the patient must be taught to evacuate the

residual urine by a catheter once or twice daily. The soft Nélaton catheter will usually enter the bladder; if it fail, the stiffer *coudé* instrument of Mercier, commonly called the prostatic catheter, generally succeeds; metallic instruments and those armed with a stylet easily lacerate the urethra and are seldom needed. All instruments used in prostatic cases should be scrupulously clean; they can be made and kept so by immersion in a 5 per cent. solution of formalin.

It is highly important that the prostatic urethra as well as the bladder should be washed by the irrigating fluid; this is accomplished by withdrawing the catheter until the eye has receded one or two inches from the bladder before the fluid is injected; after the injection the catheter can be pushed back until the outward flow begins. Many of these patients readily learn to inject the bladder from the meatus without using a catheter—a method sometimes advantageous.

Internal medication has hitherto proven of little benefit in these cases; but the writer can recommend the continued use of sodium salicylate, 10 grains three times daily, and of thiosinamin,  $\frac{1}{4}$  to  $\frac{1}{2}$  grain three times a day, as serviceable; the latter remedy has an undoubted influence in diminishing the fibrous tissue always present in greater or less degree.

In advanced cases certain complications arise which may render surgical interference inevitable; these are complete retention, persistent cystitis of great severity, and such distortion or stenosis of the prostatic urethra as renders catheterism very difficult or painful.

*Complete retention* is a serious event; when called to such a case the physician should observe three rules of great importance: 1. Never to use force nor lacerate the urethra—that is, to use only flexible instruments; 2. To observe strict aseptic precautions as to instruments and urinary channel; and 3. Never to empty the bladder completely at the first catheterism.

The patient suffering from complete retention should have a hot water enema, followed by a  $\frac{1}{4}$ -grain morphine suppository; a hot hip-bath or fomentation should be used for a quarter or half an hour, the patient then warmly covered in bed, the hips being elevated above the shoulders. The anterior urethra is irrigated with hot water injected with warm, clean oil; a clean soft catheter, No. 10 or 12 English scale, is filled with the oil and introduced, the penis being drawn firmly forward; steady pressure often forces the instrument into the bladder; if this effort fail an elastic prostatic (Mercier) catheter should be tried; if no false passage exists this instrument can always be made to pass the prostatic obstruction without injury. If, however, the urethra is already lacerated by the previous use of metal instruments the difficulties of catheterism are enormously increased; even then the Mercier instrument is to be preferred,

though occasionally a metal catheter of large diameter and long curve may be used; but force must be scrupulously avoided, for no one can know the direction of the distorted and swollen prostatic urethra, and forcible catheterism results only in false passages, profuse hæmorrhage, and a trying situation.

In cases which have been thus forcibly handled, suprapubic aspiration is sometimes inevitable; the needle should be entered at right angles with the spine about an inch above the upper border of the symphysis, half of the estimated contents of the bladder withdrawn, hot fomentations again applied, and the patient kept in bed for some hours: the relief of bladder-tension and the reduction of prostatic œdema thus secured may result in easy catheterism at the next attempt, or even in voluntary urination; but should retention persist and catheterism remain impossible, aspiration must be superseded by one of the methods of operative relief.

Should the physician succeed in introducing the catheter, he should not at once evacuate the bladder completely: sufficient urine should be withdrawn to give the patient complete relief, and an ounce or two of some antiseptic solution injected; in the course of a few days the bladder may be thus gradually emptied. Even with the greatest care some fever usually follows complete retention requiring the use of the catheter, yet the ill effects are minimized by the measures described. Persistent cystitis of high grade, and difficult catheterism from prostatic distortion, must often be relieved by surgical measures.

OPERATIVE TREATMENT.—Surgical treatment comprises three operations: Drainage of the bladder, prostatectomy, and castration.

1. *Drainage of the bladder*, by either perineal urethrotomy, suprapubic cystotomy, or a combination of the two, is the simplest, safest, and surest method of temporary relief; the suprapubic is superior to the perineal incision because of the greater command of the bladder-cavity afforded by it. Drainage of the bladder may be temporary or permanent; in many cases the cystitis and inflammatory swelling entirely subside in two or three weeks, after which the tube may be removed and the wound permitted to heal; the patient may then enjoy years of freedom from urinary discomfort. In other cases where the prostatic enlargement and distortion are found to be so great as to render a speedy return of the urinary difficulties probable, the artificial opening may be made permanent by having the patient wear constantly a rubber or silver tube, which is removed daily for cleansing. The permanent fistula has, however, fallen into disfavor, having been supplanted by the following operations:

2. *Prostatectomy*—the removal through combined suprapubic and perineal incisions of projecting outgrowths of the prostate and the restoration of a low-level channel from bladder to urethra—has



become a standard operation. The prostatic tumors, when pedicled, are removed by scissors, snare, or cautery; when imbedded in the prostate they are enucleated through either the suprapubic or perineal opening: large masses of prostatic tissue can thus be removed with surprisingly small damage to the mucous lining of the bladder. The hæmorrhage is usually slight and easily controlled by hot water and packing with iodoform gauze; the prostate is thoroughly stretched by the finger, and any bar at the vesical orifice freely incised. The mortality of this operation, at first 25 per cent., is now in skilful hands reduced about one-half; the results range from a complete restoration of the urinary function on the one hand to merely an increased facility of catheterism on the other; the prognosis varies, of course, with the patient's general condition as well as with the previous duration of bladder atony.

3. *Castration*, the removal of both testicles—a plan suggested by the frequent atrophy of uterine fibroids after the removal of both ovaries—has been extensively practised during the last four years for the relief of sufferers from prostatic hypertrophy. In a considerable percentage of the cases already reported great relief from cystitis has been secured, and in some the power of voluntary urination has returned; in a smaller number more or less complete failure to secure any benefit whatever has been the result; in some instances double castration has been recommended and even performed in cases where an undiscovered stone was subsequently found to be the cause of the trouble; for it is sometimes impossible to detect by the sound a calculus hidden in a pocket of the bladder.

This operation, the mortality from which rivals that from prostatectomy, has been most frequently successful in cases where the prostatic enlargement was soft and inflammatory rather than hard and fibrous—that is, in cases of the same sort as are relieved by simple drainage of the bladder. The unquestioned fact that a vesical calculus, tumor, or tuberculosis may escape detection by an expert surgeon renders it apparent that double castration should be performed only after a digital exploration of the bladder has been made; and the drainage following such exploration will often accomplish all that could be hoped for from castration.

Ligature of both vasa deferentia has been found to afford much relief in some cases of prostatic hypertrophy; since it is a relatively slight (although not absolutely safe) operation, free from the æsthetic objections to double castration, it may be substituted for the latter as a purely tentative procedure.

The incision of the vesical orifice by the instrument of Bottini has been recently resurrected and extensively tried. The results include a mortality of 8 per cent. and variable degrees of success, as

might be expected from the uncertain character of the operative procedure. Whether or not this operation will win approval remains to be determined ; it is still in the experimental stage.

To summarize : When surgical interference becomes necessary it should consist in temporary drainage of the bladder with stretching of the prostatic urethra ; if this exploration reveals such distortion and overgrowth of the prostate as renders a cure by simple drainage improbable, the surgeon must be prepared to make either a prostatectomy, a ligation of both vasa deferentia, a double castration, or a permanent fistula—according to the condition and previously ascertained preference of the patient.

#### CANCER OF THE PROSTATE.

Cancer of the prostate, including carcinoma and sarcoma, is a not infrequent disease, occurring chiefly in patients under ten and over fifty years of age ; while most of these tumors are found on histological examination to be carcinoma, the clinical distinction is often impossible and always unimportant.

The symptoms of primary prostatic cancer are hæmaturia, pain, and cystitis ; the bleeding occurs without apparent provocation and is intermittent ; pain is felt in the rectum, perineum, and thighs, especially after urination ; cystitis may be long delayed. The diagnosis is in the early stages difficult, cancer being often indistinguishable from the more frequent hypertrophy of the prostate ; the most important and constant diagnostic signs are progressive emaciation and pallor ; hard enlargement of lymph-glands in the groins, pelvis, and Scarpa's triangle ; and irregular nodular enlargement of the prostate. Cancer is often grafted upon senile hypertrophy ; the discovery of recognizable cancer-tissue in the urine, or the detection of a malignant ulcer through the cystoscope, is conclusive evidence. In elderly men the disease lasts several years ; in children death ensues in a few months.

The treatment of prostatic cancer is only palliative ; for, although the cancerous prostate has been extirpated several times, the patients who survived the operation have all died of recurrence within a few months. Pain may be mitigated by morphine ; cystitis, hæmorrhage, and urinary retention treated symptomatically ; and when other measures fail to relieve the vesical distress a permanent suprapubic exit for the urine may be made by puncture with a trocar, through whose canula a soft rubber catheter is introduced.

## DISEASES OF THE BLADDER.

## CYSTITIS.

CYSTITIS is a bacterial infection of the bladder; the pyogenic bacteria (especially the colon bacillus), the tubercle bacillus, and the gonococcus are the species concerned.

Pyogenic bacteria are incapable of infecting a normal bladder—a statement proven by experiment and illustrated by the frequent harmless introduction of unclean catheters and sounds. When, however, the nutrition of the bladder is impaired, as by a calculus, prostatic enlargement, or deep urethral stricture, the pus-microbes—gaining easy access from rectum, urethra, and blood-current—infect its walls, producing the inflammatory reaction which we call cystitis. Hence this disease, when neither tuberculous nor gonorrhœal, is a secondary, not a primary, morbid condition.

The classical symptoms of cystitis—frequency and pain in urination and pyuria—really indicate inflammation of the prostatic urethra rather than of the bladder; but they may be caused by an irritation of the renal pelvis, such as stone or tuberculosis, and by seminal vesiculitis; they should therefore not be considered to warrant a diagnosis of cystitis; in fact, the differential diagnosis as to the cause of these symptoms is sometimes impossible without the cystoscope.

The TREATMENT of cystitis endeavors to discover first the location and second the cause of the morbid condition producing the symptoms: the site of the lesion may be the bladder, the prostatic urethra, the renal pelvis, the seminal vesicles; the antecedent morbid condition may be gonorrhœa, a tight stricture of the deep urethra, prostatic enlargement, stone or tumor in the bladder or prostate, tuberculosis of the genital organs, or perirectal abscess. Since these conditions require widely different treatment, it is evident that there is no treatment applicable to cystitis in general beyond the removal of the cause. When this is impossible the patient's suffering may be diminished by the internal administration of urotropin; by washing the deep urethra and bladder with hot water containing silver nitrate (1:5000), or sodium chlorate (1:200), or by the injection into the bladder of liquid vaseline; lesions of the spinal cord and constitutional conditions such as gout and lithiasis must not be overlooked.

## TUMORS OF THE BLADDER.

These may be divided into three classes: papilloma, fibroma, and cancer; they occur oftener in males than in females, and mostly in the second half of life. They usually give rise, at some stage of their growth, to three symptoms—hæmorrhage, pain, and cystitis. Bleed-



ing from a tumor is often distinguished by three features: its occurrence independently of exercise, indeed frequently during sleep; its abundance, perhaps filling the bladder with clots; and its increasing frequency. The pain of a vesical tumor accompanies malignant rather than benignant growths, and tumors of the trigonum rather than those more remotely situated; cystitis is a common though often a late result of a bladder tumor.

There are but two positive diagnostic signs whereby a vesical tumor is distinguished from calculus and tuberculosis—the appearance in the urine of fragments of the growth, and ocular detection by the cystoscope. The degree of malignancy of the growth is likewise often problematical: a tumor in a young patient, causing much bleeding and no pain, is generally a benignant papilloma; a tumor in an old person, causing severe and radiating pains, is usually malignant: between these two extremes are many cases in which the degree of malignancy can only be conjectured, even when fragments are found in the urine or caught in the eye of a catheter; transformation from benignancy to malignancy certainly occurs in some bladder tumors: operative removal, when incomplete, seems to hasten this change.

In every case of obscure bladder disease the interior of the organ should be inspected through the cystoscope. Tumors will usually be found at or near the trigonum; papillomata can be easily recognized as slender, warty growths, similar to the pointed condylomata of the external genitals; fibromata are less easily distinguished from the folds of mucous membrane; cancerous growths are usually sessile tumors, whose surfaces may be ragged, ulcerated, or papillomatous; this latter feature has led to confusion of the malignant tumors with the benignant papillomata. The distinction between them exists in the base rather than in the surface of the growth; though the color of this surface is often distinctive, the benignant tumors being pink and the malignant gray.

TREATMENT is palliative and radical. The bleeding may be controlled by the internal administration of turpentine oil, 3 to 5 drops on sugar or in emulsion three to five times daily, and by injecting into the bladder a 4 per cent. solution of gelatine (gelatine, 40 parts; sodium chloride, 7 parts; distilled water, 1000 parts; to be sterilized by boiling for fifteen minutes). The subcutaneous injection of a 2 per cent. solution of gelatine—3 to 4 ounces being injected into the buttock, or back—may arrest bleeding from the urinary tract as well as from other organs. Pain is controlled by morphine, and cystitis by the treatment already suggested. In favorable cases (as determined by the cystoscope), the tumor may be excised through a suprapubic cystotomy; the results of such excision have been often favorable for benignant, but unsatisfactory for malignant growths,

for in the latter class the complete removal of the dense base is often impossible even with resection of the bladder-wall; and incomplete removal seems to accelerate the malignant infiltration.

In general, vesical growths which have infiltrated the bladder-wall, as revealed by the finger in the rectum or after excision in the bladder, are not suitable for radical operation; those, on the other hand, whose bases are normal tissue, can be removed with a fair prospect of cure, or at least of long freedom from recurrence. Even in cases of cancer a suprapubic incision may be needed for the arrest of hæmorrhage or for the relief of cystitis by the establishment of a permanent fistula.

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### KIDNEY, PELVIS, AND URETER.

THE upper urinary passages are subject to three bacterial invasions—gonorrhœal, septic, and tuberculous; and to the formation of calculi and tumors.

#### PUS-INFECTION; PYELITIS (SURGICAL KIDNEY).

The various pyogenic infections are sequels of gonorrhœa, chronic septic infection of the bladder (chronic cystitis) such as results from prostatic enlargement, vesical calculus, and tight stricture of the deep urethra; they may also result from catheterism in the puerperal state. Less frequently septic infection of the kidney and its pelvis comes from the blood-current, as a complication of general infections, such as typhoid fever, diphtheria, etc.

Acute pus-infection of the upper urinary passages is marked by chills, fever, pain over the kidney and along the course of the ureter, down the thigh and in the corresponding testicle, which may be retracted; it is, however, more often a chronic disease, and is then a gradual process whose symptoms may be masked by the more prominent signs of coexistent cystitis.

TREATMENT aims to arrest the cystitis of which the pyelitis is often the extension, by the careful dilatation of a urethral stricture, the removal of a vesical calculus, etc. In cases of severe cystitis and pyelitis from prostatic enlargement, simple drainage of the bladder for a few weeks may be followed by a cessation of the inflammation in the upper urinary channel. The internal administration of urotropin and the external application of guaiacol in full medicinal doses are important adjuncts in treatment. In women the ureter can be catheterized and irrigation of the ureter and kidney-pelvis made with hot water containing hydrastis or other local anti-septic.

The differential diagnosis between pus-infection, tuberculosis, and calculus of the renal pelvis often taxes our present means of diagnosis. In every case of pyelitis the physician should make a microscopic examination of the urine, noting pus, blood, crystals, and bacteria; then with the cystoscope it can be seen from which ureter the pus issues; and from the conspectus of symptoms a diagnosis of greater or less certainty is made. Yet, after most careful and thorough examination and confident diagnosis, competent surgeons have opened the kidney and found their conclusions erroneous.

#### MOVABLE AND FLOATING KIDNEY.

Abnormal mobility of the kidney is congenital or acquired; the movement may take place behind the peritoneum (from laxity of the renal attachment) or within the abdominal cavity (from the enclosure of the kidney in a distinct envelope of peritoneum, a mesonephron). The former, the movable kidney, is far more frequent than the latter, the floating kidney; although this anatomical distinction is not often clinically practicable until the kidney is exposed. Movable kidney is found usually in women, especially in those who have borne several children; but it is not rare in men.

The symptoms vary from almost nothing to a degree of pain that incapacitates the patient for active bodily movement—a dragging sensation in the abdomen which may be aggravated by movement, standing, constipation, or menstruation into a sharp pain resembling renal colic, and perhaps accompanied with nausea. Upon palpation with the patient in various positions a tumor can usually be discovered corresponding in size and shape with the normal kidney, located anywhere in the abdomen or pelvis, and generally capable of reposition in the normal locality when the patient's hips are elevated.

The treatment endeavors to retain the kidney in its normal position, either by a truss (which often fails, especially in fleshy patients) or by nephrorrhaphy (nephropexy).

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#### TESTICLE AND EPIDIDYMIS.

ACUTE inflammation of these organs is due to gonorrhœa, septic infection, trauma, or the general infection of mumps, typhoid fever, or other acute bacterial diseases. The essentials of local treatment are hot fomentations, the application of guaiacol (15 minims, dissolved in three times that quantity of glycerin), three times daily, and the thorough suspension of the inflamed organ against the symphysis, by means of a jockey-strap or similar bandage enclosing cotton and oiled silk, next the skin.



The chronic diseases are all accompanied by enlargement of these parts, and the differential diagnosis is therefore a comparative study of these enlargements.

TUBERCULOSIS usually begins in the epididymis as hard, nodular swellings like shot, later coalescing into a cord; the tuberculous tissue may become adherent to the skin, soften and ulcerate, making an obstinate sinus. Digital examination *per rectum* usually shows a similar condition of the seminal vesicles and prostate.

SYPHILIS on the other hand usually attacks first the testicle, making a smooth, painless enlargement and not involving the prostate.

CYSTIC DISEASE is a slow-growing, painless tumor, the fluid nature of which can be established by the aspirating needle.

CHRONIC EPIDIDYMITIS and orchitis may cause great enlargement of these organs, which are usually painful and sensitive to pressure; abscess and cyst-formation may occur.

CANCER of the testicle (carcinoma and sarcoma) is most frequent in the second half of life, and can sometimes be distinctly traced to a blow. In the early and slow stages there may be no positively distinctive feature from the cystic and inflammatory enlargement, but the active stage is marked by rapid growth, constant pain, induration of the inguinal and pelvic lymph-glands, and finally emaciation and cachexia.

The treatment of these several conditions has been previously suggested.

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## DISORDERS OF INSEMINATION.

THE function of the male in reproduction is the deposit of motile spermatozoa on the cervix—insemination. Defects in this function are called impotence and sterility, the former implying inability to copulate, the latter (when not caused by impotence) the absence of moving spermatozoa from the semen.

### IMPOTENCE AND STERILITY.

**Impotence.**—When not resulting from malformation, inability on the part of the male to copulate is caused by either imperfect erection or premature ejaculation. Normal erection consists in the distention of the cavernous and spongy bodies with blood, which is brought about by the dilatation of the penile arteries and the constriction of the venous exits; and this in turn results from the contraction of the perineal and penile muscles stimulated through branches of the second sacral nerve from the genital centre in the lumbar cord. This centre responds to stimulation from either the brain or the nerve-endings dis-

tributed in the penis from prostate to glans ; hence erection may be induced through excitement of this centre by sexual thoughts, or by influences from the periphery such as friction of the glans, congestion of the prostatic urethra by a distended bladder (morning erections), etc. ; the genital centre may also be directly stimulated by certain drugs taken into the blood such as cantharides and alcohol. Ejaculation of semen is accomplished by the same apparatus stimulated to a higher degree, resulting in a contraction of the genital muscles, which begin in the fibres of the broad ligament, and continues through the prostate and perineal compressors.

Feebleness or absence of erection may therefore be caused by any one of the following factors : 1. Depression of the genital centre by the brain, from fear, grief, anxiety, disgust ; 2. Depression of the genital centre through imperfect nutrition, as in diabetes mellitus ; 3. Diseases of the spinal cord, such as ataxia and myelitis ; 4. Exhaustion of the genital centre by excessive sexual activity, whether in intercourse or masturbation ; 5. Disease of the nerve-endings in the genital tract, especially the prostatic urethra, caused by inflammation—the commonest form of impotence. This chronic inflammation of the prostate results usually from gonorrhœa or from sexual excess.

The subject of this form of impotence often complains of pain in the sacrum, suprapubic region, perineum, and testicles ; anxiety and despondency are marked features. A diagnosis can be made by a digital examination of testicles, prostate, and seminal vesicles ; gentle pressure (“milking”) of the latter organ often causes the appearance of a milky fluid at the meatus.

The TREATMENT of impotence will naturally be determined by the cause ; excluding cases of diabetes, spinal-cord disease, etc., the treatment is mental and local. The false and terrifying ideas which the patient has probably derived from the perusal of quack literature should be corrected and a cheerful prognosis given. The local treatment is that for chronic inflammation of the prostate and appendages already described—milking of these organs, deep injections of weak silver-nitrate solution, alternating hot and cold sponging of the perineum and external genitals, and pills of camphor monobromate ; strict limitation of sexual excitement, mental and physical diversion and hygiene are important. The prognosis varies with the age of the patient and the cause of the impotence ; the most favorable cases are those due to gonorrhœa in the young. Direct stimulation of the sexual organs by drugs should be avoided, though strychnine, arsenic, iron, and phosphates may improve the general condition.

**Sterility.**—Failure to fertilize the female may be due either to inability to deposit the seminal fluid in the cervix (impotence) or to the absence of moving spermatozoa from that fluid (sterility proper) ;

the latter may exist when the power of copulation is unimpaired. In these cases no spermatozoa whatever are found in the semen (azoospermia), or the spermatozoa emitted are nearly or quite motionless; this absence of motion, entailing sterility, may be due to a chronic inflammation in some part of the seminal tubes, especially prostate and vesicles.

The TREATMENT of sterility depends upon the cause: if the freshly passed semen, received in a condom, contains no spermatozoa, treatment is useless unless a double epididymitis exist, in which case daily massage of the indurated tissues with mercurial ointment should be made for several weeks. If spermatozoa be present, though lacking motility, the usual treatment for chronic inflammation of prostate and vesicles should be made.

#### INVOLUNTARY SEMINAL DISCHARGES.

These occur in two ways: 1. *Nocturnal emissions*; 2. *Spermatorrhœa*.

Seminal emissions with the natural orgasm, occurring during sleep and with an erotic dream, are experienced by healthy, continent men at intervals of ten to thirty days; when not followed by languor or sacral pain they may be considered compatible with health. Emissions occurring at short intervals and followed by lassitude and pelvic pains commonly arise from abnormal excitement of the genital tract, such as follows habitual masturbation, sexual excitement without gratification, or the extension of a gonorrhœal infection to the prostate and vesicles. Treatment should include instruction in the hygiene of the sexual organs, especially the avoidance of ungratified sexual excitement in every form and sexual excess. Monobromate of camphor, two grains night and morning, will usually lengthen the intervals between nocturnal emissions by decreasing the excitability of the genital centre in the cord; if congestion of the prostate and vesicles exist it should be reduced by the passage of large cold sounds, the hot and cold perineal douche, deep injections of silver nitrate solution, milking of the parts, etc.

Spermatorrhœa should mean the involuntary escape of seminal fluid without orgasm; while it may occur under sexual excitement, it is usually observed merely at the close of defæcation or urination. Under the latter circumstances the fluid pressed out at the meatus, though resembling semen, often contains no spermatozoa, being in fact merely prostatic secretion; and the condition should be called *prostatorrhœa*. Yet, whether it contain spermatozoa or not, the habitual appearance of this fluid indicates a chronic inflammation of the genital organs, which should be treated by the measures already recommended for that condition.



## GENERAL NOTES.

## DIAGNOSTIC NOTES.

**PAIN.**—Pain in the urethra, especially in the fossa, is a common symptom of inflammatory affections of the prostate; pain in the sacral and suprapubic regions often accompanies chronic inflammation of prostate and vesicles; these latter conditions may also cause pain referred by the patient so distinctly to the rectum that he assumes the existence of disease in the bowel. Pain in the lumbar region, extending along the ureter to the testicle, indicates an irritation of the kidney-substance or of the renal pelvis, and may be caused by a calculus, tuberculosis, or partial obstruction of the ureter (from stricture or kinking).

**PYURIA.**—The detection of the source of pus in the urine—an accompaniment of many diseases of these organs—sometimes taxes the physician's diagnostic power; for, aside from the anterior urethra, any part of the urinary channel and either of the seminal vesicles may be the origin of the pus which is present in the urine. In a general way the three-glass test, already described, may indicate the source; but the specific site and cause of the suppuration may require a careful weighing of all symptoms and even inspection of the bladder and ureteral orifices through the cystoscope. No inferences can be properly drawn from the gross appearances of the pus nor of the accompanying epithelium, unless this be the atypical fragment of a malignant tumor.

**HÆMATURIA.**—The source of blood mixed with urine can usually be detected with reasonable certainty; in general it proceeds from either prostate, bladder, or kidney. Bleeding from the prostate usually arises from conditions, such as cancer and tuberculosis, which are recognizable by the finger in the rectum; bleeding from the kidney is often symptomless, while hæmorrhage from the bladder often proceeds from morbid conditions that are preceded or accompanied by great vesical irritability. Yet in many cases positive knowledge as to the source of hæmaturia must be obtained through the cystoscope, whereby not only the vesical cavity but also the orifices of the ureters can be inspected.

**ALBUMINURIA.**—Albumin may appear in the urine independently of nephritis in any condition which causes frequent spasmodic contractions of the bladder, such as acute prostatitis, tuberculosis, or tumor near the vesical orifice. The escape of albumin from the renal vessels seems to result from the increased pressure in the tubules resulting from undue contraction of the lower end of the ureters. With the subsidence of the vesical irritation albumin disappears from the urine.

**VESICAL IRRITATION.**—Frequent and more or less painful urination indicates really an irritation of the prostatic urethra rather than of the bladder; it may be due to a morbid condition which does not involve the bladder, but is located at any point of the urinary channel from meatus to renal pelvis, or even in the seminal vesicle; at times, too, it may result from the presence of acrid substances in the urine without local disease of the urinary passages. It is a frequent symptom of tuberculosis of the renal pelvis, of stricture of the ureter, and of seminal vesiculitis.

**FEVER.**—The thermometer should be used as a routine part of urinary diagnosis: an irregular temperature may be an important factor in distinguishing between various conditions, such as the tuberculous and the septic infections of inaccessible parts like the kidney.

#### DIGITAL EXAMINATION PER RECTUM.

This is essential in the case of every patient seeking relief from disease of the urinary or genital organs; it reveals important morbid conditions of prostate and vesicles, and materially assists the exploration of the bladder by a sound. The disagreeable features of such examination are largely obviated by enclosing the finger in a rubber condom, which is then anointed with glycerin (rubber dissolves in fats).

#### THE CYSTOSCOPE.

The electric cystoscope of Nitze or Leiter, or one of the later modifications of this instrument, is a most valuable, sometimes essential, means of diagnosis. Some diseased conditions can be detected only by its aid; in others the cause of symptoms can be identified and located only by the same instrument. It is therefore required for the recognition of primary vesical tuberculosis and tumors; for detecting the source of vesical hæmorrhage; for differentiating between renal and vesical hæmaturia or pyuria; for ascertaining whether one or both kidneys are the seat of a suppurative process; and for deciding whether an apparently normal kidney is secreting its proper share of urine. In addition it is often useful in the detection of encysted and pocketed stones inaccessible to the sound, and in the visual location of foreign bodies: through the modified instruments of Casper and Nitze the ureter has been catheterized in the male. In short, in many cases of obscure urinary disease the cystoscope is indispensable.

There are, however, certain limitations to its use: prominent among these is the extreme sensitiveness of the bladder which renders that viscus incapable of retaining the minimum quantity of water essential to cystoscopic examination, namely, four or five ounces; this condition results most frequently from tuberculosis of the bladder or prostate,

and from acute septic conditions—all of which would be injured by any instrumentation; profuse bleeding into the bladder renders satisfactory cystoscopic examination impossible through the rapid obscuration of the visual field. Aside from these cases there are but few in which cystoscopic examination cannot be made in the adult even without anæsthesia; through this instrument the physician can inspect the surface of the bladder and may find an unsuspected stone, tumor, or ulcer as the cause of previously unexplained symptoms; he can observe not only the absence of pus or blood from the stream issuing from each ureteral orifice, but also note possible swelling around that orifice (often indicating ureteritis and pyelitis); and by counting the jets of urine from each ureter he can make a fair estimate as to the relative amount of fluid secreted by each kidney: this item may be of great importance when a surgical operation on either kidney is contemplated.

#### THE URETHROSCOPE.

Of the many instruments devised for the purpose of rendering the urethral surface accessible to the eye, but three types deserve mention: 1. The simple cylindrical tube through which light is reflected from a head-mirror; 2. The electric urethroscope, the incandescent lamp in which is carried either at the outer or the inner end of the tube; 3. The aëro-urethroscope (devised by Antal and improved by Fenwick), by which the urethra is inflated with air during the inspection. The last-named method gives the only satisfactory view of the urethra, but it can be used for obvious reasons only in the penile portion; for the inspection of the deep urethra one of the other instruments must be employed. In a limited number of cases the urethroscope is most valuable: certain cases of gleet dependent upon localized diseased areas, and cases of morbid sensations due to similar areas and to polyps, can be cured only through the aid afforded by this instrument; yet it must be admitted that these cases are not numerous.

#### CATHETERISM OF THE URETERS.

The aid in both diagnosis and treatment to be derived from the introduction of a catheter into the vesical orifice of the ureter has long been apparent, and for many years different means to that end have been devised; only recently, however, has catheterism of the ureter become entirely practicable in the female and possible in the male. By the method of Kelly and Pawlik the introduction of a special catheter into the ureter of the female can now be accomplished, usually without anæsthesia. By greatly elevating the hips of the patient, the bladder becomes distended with the air which enters through a tube 40 mm. or more in circumference, which is introduced



after the urethra has been gradually dilated by conical plugs. Light reflected from a head-mirror reveals the ureteral orifices, into which a delicate catheter or sound can be passed; and elastic bougies can be made to traverse the ureter to the pelvic brim, sometimes even to the renal pelvis.

By this method the urine from each kidney can be separated from that of its fellow as well as from admixtures furnished by the vesical surface—the diagnostic advantages of which are apparent; moreover, strictures of the ureter are detected and even dilated; and it has been found possible to flush the renal pelvis itself.

In the male the ureter can often be catheterized by the aid of special cystoscopes, notably that of Casper; yet the mechanical difficulties due to the presence of the cystoscope materially limit the practical results of this measure.

The separate collection of the urine directly from the respective ureters has been recently attempted by Neumann and Harris, the bladder being more or less completely partitioned into two cavities by a lever introduced into the vagina of the female, the rectum of the male. The theoretical defects of these instruments are two: 1. Each tube drains half the bladder as well as one ureter; and 2. The separation of the two cavities can be only probable, not certain. These defects have been demonstrated in practice, and vitiate the value of the instruments.

#### THERAPEUTIC NOTES.

**TINCTURE OF CANTHARIDES**, in 1- to 3-minim doses, often exhibits a marked influence in quieting vesical irritation ("cystitis") as well as in decreasing congestion of the sexual organs (chordee, nocturnal emissions). This is empirical (and uncertain) therapeutics.

**ANTIPYRIN** may be advantageously substituted for morphine for the relief of vesical irritation.

**COCAINE** should be used in the urethra with extreme caution, if at all; the records show a surprisingly large number of cases of toxic effects from simple surface applications.

**GUAIACOL**.—The anti-pyogenic and anæsthetic effects of this drug find a wide application in the treatment of genito-urinary diseases. As a local application (1 part to 3 of glycerin or olive oil) it is valuable in the treatment of epididymitis, whether gonorrhœal, septic, or tuberculous. Administered by the mouth, especially when combined with salicylic acid, which dissolves readily in it, guaiacol has a demonstrable value in limiting pyogenic processes in any part of the genito-urinary organs.

**NUCLEIN**.—The various preparations supposed to depend for their activity in part at least upon nucleic acid—Vaughan's solution,

thyroid extract, protonuclein—have a decided, though varying, effect in combating septic and tuberculous infections; they should be given internally, and when practicable applied locally.

**SILVER SALTS.**—Certain salts of silver, especially the citrate and lactate, have demonstrated their efficacy as local means for combating septic infection, and have been used in watery solution (1 part to 500 or more of water) for irrigating pus-cavities and the urethra.

**THIOSINAMIN**, made from mustard oil by the action of ammonia, is a valuable agent for the gradual removal of cicatricial tissue. In  $\frac{1}{4}$  to  $\frac{1}{2}$ -grain doses, dissolved in alcohol and water, three times daily for weeks together, it causes a perceptible absorption of the fibrous tissue of strictures, prostatic fibroids, and cicatrices.

**TURPENTINE OIL** is a good internal hæmostatic, especially for renal bleeding: it should be given in 1- to 3-drop doses, on sugar or in emulsion, every three hours.

**GELATIN** is a valuable local styptic; it should be warmed to fluidity and applied directly to the bleeding surface. In some conditions, at least, the subcutaneous injection of a 2 per cent. gelatin solution has promptly arrested hemorrhage from inaccessible localities, such as the kidney, uterus, and lung. Three or four ounces of this solution may be injected into any convenient part; and the injection may be repeated in four hours if needed. The gelatin solution should be sterilized by boiling prior to its subcutaneous use.

# THERAPEUTICS OF THE GENITO-URINARY DISEASES OF WOMEN.

By EDWARD E. MONTGOMERY, M. D.

## INFLAMMATORY DISEASES.

THE recognition of the dominant influence of bacteria in the production of the various forms of inflammation has necessarily led to many modifications of our plans for the treatment of diseases of the genito-urinary tract in women. Its acceptance cannot but impress the physician with the importance of the most conscientious practice of cleanliness, not only in operative procedures, but in the ordinary manipulations for examination and local treatment. When we review the early record of this branch of practice it becomes a serious query, from which the patient has endured the greater risk—her disease, or the efforts pursued for its relief.

In the study of inflammation of this tract, the interdependence of the various local forms should not be forgotten. Thus, it is difficult to conceive of a severe inflammation of the vagina without an involvement of the vulva and cervix. The rapid extension of inflammation through the entire tract, lined as it is by a continuous membrane, justifies us in the consideration of the "inflammatory diseases" of these structures as a group. The frequently rapid progress of serious inflammation, the early production of pathological changes which impair or destroy the function of the reproductive organs, and the peril to the future comfort or even life of the individual, justify such an arrangement of the subject.

The predisposition to the development of local inflammation is largely due to improper hygiene. Improperly constructed, insufficient and injudicious clothing, poorly regulated diet, want of care and cleanliness, neglect of exercise, are all important factors.

While we may not always be able to establish the original site of an inflammatory process, for purposes of study and description, it is more convenient to take up its consideration in a progressive course from without inward.

## INFLAMMATIONS OF THE GENITAL TRACT.

Vulvitis.—Inflammations of the vulva present diverse appearances according to the structures involved and the cause of production.



Attempts have been made to indicate these differences by designating them as various forms of vulvitis, but when we recognize that in each case it is inflammation, the division into diffuse and circumscribed would seem preferable. The latter term may be applied to what is sometimes known as follicular vulvitis.

Inflammation of the vulva may arise from want of cleanliness, from decomposing lochia or menstrual discharge, from diabetic or decomposed urine, or constant bathing of the parts with urine, as in a vesical fistula or from incontinence, from uterine or vaginal discharge, gonorrhœal infection, puerperal sepsis, and in young children, from seat-worms.

The TREATMENT will depend upon the cause and extent of involvement. A slight inflammation of the vulva may arise from want of cleanliness, and the consequent retention of decomposing secretions. The skin between the folds of the labia majora and minora is richly provided with sebaceous glands. The decomposing sebaceous matter mixed with the vaginal secretion produces an exceedingly unwholesome and offensive odor, the tissues become irritated, scalded, and abraded. Pruritus is intense. Frequently, careful washing with soap and hot water, and the separation of the parts by pledgets of cotton, oakum, or lint, leads to speedy relief.

The treatment of the gonorrhœal form will be discussed with the subject of Vaginitis.

The first step in the treatment of any form of vulvar inflammation must be the determination and removal of its cause. The urine should be carefully examined. The association of vulvitis with diabetes may be suspected when the inflammation extends over the labia, perineum, and adjacent surfaces of the thighs, particularly if the parts present numerous whitish points or tufts, the algæ, or yeast-fungus. The pruritus is intolerable.

The diffuse variety is not infrequently complicated by inflammation of the orifice of the urethra, the ducts and glandular structure of Bartholin's glands, the loose cellular tissue, and the inguinal lymphatic glands.

In the acute forms the patient should be kept quiet, the parts frequently washed or douched with an antiseptic fluid—corrosive sublimate (1 : 5000), carbolic acid (1 : 50), or formalin (1 : 2000).

In the early stages the application of cold, the ice-bag, or cold lotions will frequently ameliorate its gravity. The ice-bag should not be continued sufficiently long to endanger necrosis. In the later stages, hot antiseptic solutions will be more efficacious: lint or gauze saturated with the solutions of sublimate and carbolic acid already named, or borax 1 : 100, covered with rubber dam or wax-paper, and kept in place by a T-bandage. Where there is much secretion the parts should

be frequently washed with hydrozone, dried with absorbent cotton or gauze dusted with iodoform and tannin (4 : 1), aristol and desiccated alum (8 : 1), or the stearate of zinc. The application of the powder, in addition to its inhibitory action upon germ-production, keeps the inflamed surfaces apart. The separation of the surfaces is very important and may be more effectually accomplished by the use of pledgets of lint, absorbent cotton, sterilized gauze or prepared oakum. The pledget may be utilized for the more continuous action of a drug by the application of diachylon ointment, ichthyol in lanolin (1 : 12), or ammoniated mercury ointment (15 grains to the ounce).

Suppuration of the vulvo-vaginal glands should indicate early incision. The opening, after irrigation, should be packed with iodoform gauze. If the gland has not broken down it is best removed, as its retention after obliteration of its duct will lead to the formation of a cyst. Abscess of the loose cellular tissue should be promptly evacuated and drained. The vulvitis produced by diabetic urine is promptly relieved by washing with a solution of sodium hyposulphite ( $\frac{1}{2}$  ounce to the pint), and keeping the surfaces apart by pledgets medicated with diachylon ointment.

The *circumscribed* or *follicular vulvitis* is frequently exceedingly obstinate; the separate hair-follicles seem to become involved without inflammation of the intervening skin. In obstinate cases it is better to shave the genitalia, puncture and cauterize with stick silver nitrate each affected follicle, and keep the parts covered with ammoniate-of-mercury ointment.

Infants and young girls not infrequently develop vulvitis from want of cleanliness. Occasional epidemics of the disease are seen in schools and infirmaries, due to infection. The development of such a condition should be considered an indication for prompt treatment, as extension of inflammation to the deeper structures is not infrequent before puberty and affects their development and the subsequent performance of their functions.

The retention of sebaceous secretion beneath the prepuce of the clitoris is capable of setting up an adhesive inflammation which fixes the prepuce over the entire glans. When it has been long continued, the glans and clitoris are poorly developed, the retained smegma often produces itching, irritation of the bladder, nervous phenomena, occasionally convulsions, and not infrequently leads to the practice of masturbation. The prepuce should be stripped back, all particles of secretion removed, and the parts subsequently be kept clean. Where the prepuce is so long as to completely envelop the glans like a hood, the reproduction of the condition may be obviated by removing with scissors a piece of skin about one-half inch above the glans and introducing sutures. Or the entire prepuce may be cut away and the wound sutured.

**Pruritus** is a very common symptom of vulvar inflammation, and is relieved by treatment adapted to the causal condition, but we sometimes find severe pruritus unaccompanied by signs of inflammation. Its existence should always lead to careful examination for a local cause. The diet should be carefully regulated and the general health improved.

Efficient local applications are a 2 to 5 per cent. solution of carbolic acid, chloral ( $\frac{1}{4}$  drachm to the ounce), diachylon ointment, or ointment containing 5 per cent. carbolic acid, and 10 grains cocaine to the ounce. In very obstinate cases, painting with a stronger solution of carbolic acid, nitrate of silver (30 grains to the ounce), or tincture of iron chloride may be required. Where the itching is confined to small spots they may be removed. Fehling gave permanent relief in an obstinate case by removing both labia majora and the clitoris. Smyly advises equal parts of powdered alum and sugar, dusted over the parts.

**Vaginitis.**—Inflammations of the vagina may be considered as acute and chronic, simple and specific, or gonorrhœal. The character of the inflammation is somewhat dependent upon the age of the patient.

The normal discharge from the vagina, according to Döderlein, is a whitish exudation of the consistence of clotted milk, of an intensely acid reaction, containing an almost pure culture of the vaginal bacillus. Other micro-organisms, as the *oïdium albicans* and the yeast-fungus, are rarely detected. So long as the vaginal discharge remains normal, the mucous surface is particularly resistant to the encroachment of disease.

It is generally contended that the vagina is rarely the original site, but becomes involved by extension of inflammation from either the cervix or vulva. The normal vaginal discharge is necessarily modified by the alkaline discharge from the cervix during menstruation, the puerperium, endometritis, and cancer. Sexual intercourse may convey saprophytes, tubercle bacilli, gonococci, and other germs.

The mucous surfaces of the vagina are rendered more vulnerable to the encroachment of disease by the causes given, by sloughing myoma and septic puerperal affections; by contact with irritating alkaline urine and fæces in vesico-vaginal and recto-vaginal fistulæ, by retention of badly fitting and foul-smelling pessaries, by the use of too hot vaginal douches, too long retention of tampons, the introduction of an infected syringe-nozzle, or careless examination with dirty hands and instruments.

Certain constitutional conditions favor the production of leucorrhœa, as tuberculosis and anæmia. Vaginitis may be caused by the exanthemata, diphtheria, erysipelas, and dysentery.



In the TREATMENT, where possible, the first consideration must be the removal of the cause.

In the acute form, the vagina may be irrigated with either hot or cold mild antiseptic douches. When severe, and especially in the gonorrhœal form, it will be complicated by inflammation of the vulva. Hot antiseptic fomentations and hot sitz-baths will be found grateful. The patient should rest in bed. The importance of early arrest of the disease should lead to active treatment. Alternate douches of hydrogen peroxide and hot water should be used every few hours. One or two ounces of the former may be thrown into the vagina to be washed away in a few minutes with a hot-water douche.

When the acute symptoms sufficiently subside to permit the introduction of a speculum, the vagina should be carefully cleansed with hydrogen peroxide and its inflamed surfaces kept separate by a light packing with iodoform or aristol gauze. The gauze should be removed the following day. The packing may be preceded by the use of a solution of silver nitrate ( $\frac{1}{2}$  drachm to the ounce), this application to be made every second to fourth day. The gauze should be removed at the end of twenty-four hours and a douche of a weak solution of lead and opium or solution of ammonium chloride (2 drachms to the pint) used two or three times daily (Collyer). G. D'Aulnoy, in gonorrhœal vaginitis, after cleansing the vagina soaks two or three tampons in a mixture of—Pyoktanin 10 parts, alcohol 15 parts, potash  $\frac{1}{2}$  part, water 200 parts. This is placed in the posterior vaginal cul-de-sac and the vulva occluded by a dry pad. This dressing is left in place two days. The pain is greatly lessened. Glycerin tampons are subsequently substituted, which are changed daily. Generally the blue stain disappears upon the fourth day and secretion from this time is absent.

In the chronic forms, cleansing, frequent douching, and the use of astringents must be our dependence. Applications of silver nitrate solution (from 10 grains to 1 drachm to the ounce) may be made by swabbing through a speculum, or in obstinate cases a weaker solution may be used with an atomizer. Insufflation of powders serves to medicate and keep the surfaces separated, as: Iodoform 3 parts, tannic acid 1 part; or, Aristol 4 parts, desiccated alum 1 part. Alum and sugar equal parts are useful. Coition should be discontinued until the disease is cured.

An inflammation of the vagina characterized by absence of rugæ and the presence of a roughened granular surface is seen following the climacteric in those suffering from a rheumatic diathesis or addicted to the use of alcoholic agents.

Constitutional treatment or the correction of the habits of living is generally efficient in affording relief.

Vulvo-vaginitis in young girls presents difficulties in its treatment, yet it is very important that it should be carefully combated. Such cases not infrequently reach puberty with chronic inflammation of the endometrium. The introduction of crayons is extremely painful. Rocaz uses through a soft-rubber catheter a vaginal irrigation of potass. permanganate 1:4000, increased in strength to 1:1000. At first a slight increase of discharge is noted which soon subsides.

In such cases Richard Pott would first remove every vestige of the hymen and then use small bougies of iodoform 5 to 8 cm. in length.

Vaginismus is so frequently associated with fissures about the posterior commissure of the vulva and is so painful as to fully entitle it to consideration under the division of inflammation. Its presence should indicate a careful examination for fissures of the vaginal and anal orifices. Occasionally points of hyperæsthesia will be found upon the sides of the vagina, to which the touch of a small brush causes agony. Such points should be removed with the knife or scissors. Muscular spasm due to the presence of fissures of vagina or anus may be overcome by giving an anæsthetic and stretching, and subsequently wearing for an hour or two daily a glass vaginal plug.

Vaginal suppositories of opium, belladonna, or iodoform may be found useful. The vulva and vaginal introitus may be painted with a 5 per cent. solution of cocaine before coitus.

Lutaud advises irrigation with potass. chlorat. et tr. opii, *āā.* 200 parts; aquæ picis, 200 parts—a tablespoonful to a quart of water—to be followed at night by the following bougie:

R <sub>y</sub> . Cocainæ hydrochlorat.,	gr. iv (0.2);
Ext. belladonnæ,	gr. ij (0.1);
Strontii bromidi,	gr. iv (0.2);
Olei theobromæ,	ʒij (8.0).—M.

#### INFLAMMATION OF THE UTERUS.

Probably no organ of the body affords greater difficulty in determining the presence of inflammation and its classification, than is experienced in the study of diseases of the uterus. Hæmorrhage and leucorrhœa, symptoms of inflammation, are not infrequently consequent to various constitutional conditions.

Leucorrhœa is frequent in constitutional conditions, as tuberculosis, syphilis, rheumatism, gout, anæmia, and chlorosis. It is quite as likely to occur as nasal or pharyngeal catarrh. Uterine hæmorrhage is a frequent symptom in the exanthemata, in malaria, in lesions of the heart, liver, and kidneys, in irritation or inflammation in the



neighboring organs, as the tubes, ovaries, peritoneum, bladder, and rectum.

A classification of inflammation that will satisfactorily cover symptoms and pathological changes is difficult to make. Probably the simplest is into acute and chronic, cervical and corporeal. In making this division, I am well aware that severe inflammation of one portion rarely occurs without in some degree involving the other, but the inflammation will predominate in the one portion sufficiently to justify the distinction.

Causes of inflammation may be divided into constitutional and local; the former by influencing the uterine circulation render the organ more assailable. The conditions which have already been named as producing leucorrhœa and hæmorrhage may justly be classed as constitutional causes of inflammation. Habits of living, mental impressions secured through erotic reading or conversation, frequent sexual excitement, inordinate sexual intercourse, and masturbation are additional causes. The most frequent cause is septic infection following abortion or parturition, either from the introduction of sepsis or the retention of decidua, clots, or portions of placenta.

Sepsis may occur in the non-puerperal from want of care in manual and instrumental procedures. Next to sepsis in its baneful influence must be placed gonorrhœa. A local cause of inflammation which may be classed among the predisposing is uterine displacement.

TREATMENT.—Pozzi justly urges the advantage of *prophylaxis* in the treatment of uterine inflammations, and urges that when there is reason to fear that portions of membrane or placenta have been left in the uterine cavity no time should be lost in their complete removal: we should not await hæmorrhage, for the mucous membrane may then be already infected. He advises the dull Récamier curette and weak sublimate injections.

The treatment may be divided into constitutional and local. The former may be to some extent proper to all forms of inflammation. Violent exercise, over-fatigue, and the sexual relation must be avoided. The healthy action of the alimentary canal must be promoted. Constipation should be overcome so far as possible by the use of food (Graham bread, vegetables, prunes, and figs), mild laxatives (mineral water), and enemata, to which glycerin should be added. An enema of a tablespoonful of pure glycerin, or a glycerin suppository, will frequently be sufficient. The daily evacuation of the bowels should be a matter of habit. This can be promoted by eating a dozen each of almonds and raisins at night and taking a glass of water before breakfast, the use of a teaspoonful of bran in water before breakfast, or with some patients a teaspoonful of white mustard in water before meals.



The long-continued use of drastic purgatives should be avoided, but it is so important to unload the lower bowel that resort to them must at times be made. The following prescription accomplishes the purpose, while at the same time it helps to overcome the disposition to constipation :

R. Aloin.,	gr. iv (0.2) ;
Ext. cascar. sagrad.,	gr. viij (0.6) ;
Ext. belladonn.,	
Ext. nuc. vom.,	āā. gr. iij (0.15).
M. et ft. capsul. No. viij.	
S. One capsule at night as needed.	

The general condition of the patient must be promoted by suitable tonics. Any special diathesis, as the rheumatic, should be combated.

The mineral waters are of value ; in anæmic patients the ferruginous, sulphur, or arsenical should be advised. Springs charged with chloride of sodium are of special advantage in scrofulous and lymphatic patients, but are of still greater advantage in all visceral engorgements.

**Acute Metritis.**—Rest in bed must absolutely be demanded, a light, readily digested diet given, and saline laxatives administered. An ice-bag or hot fomentations, according to which affords the most comfort, should be applied over the abdomen. Hot vaginal douches (110° to 120° F.) of large quantities of water are of service. Blood-letting may be employed with advantage. The cervix is exposed by a speculum, cleansed, and a number of punctures made with a spear-shaped scarificator, a bistoury, or a needle. The bloodletting may be followed by a pad of iodoform gauze or with a tampon saturated with glycerin.

The glycerin has an affinity for the watery portions of the blood and exercises a hydragogue effect by unloading the engorged vessels. Barbour prefers a 10 per cent. solution of ichthyol in glycerin. If the tenderness is so marked that the tampon is not well borne, he uses an ichthyol suppository. Exfoliative metritis, known as membranous dysmenorrhœa, should be regarded as indicating the use of the curette. If it is associated with contraction of the cervix, the curette should be preceded by dilatation and followed by painting the cavity with a strong solution of iodine. For acute gonorrhœal metritis Pozzi uses the curette, followed by intra-uterine cauterization with strong chloride of zinc by means of cotton rolled on probes. Gonorrhœal arthritis has been known to follow such treatment.

**Chronic Metritis.**—Chloro-anæmia is an early symptom, so constitutional measures must be employed to supplement local treat-

ment. Thorough antisepsis of the vagina is important. The measures employed to secure it will have a beneficial influence upon the uterus, and especially the cervix, which is generally the part most affected. Douches, sublimate (1:3000), carbolic acid (1:50), at a temperature of 115° F., may be frequently repeated. The former should not be continued for too long a time for fear of poisoning. In severe cases, the treatment to be effective must attack the cavity of the uterus, and may be by antisepsis, cauterization, or curettement, or a combination of all. The uterine cavity may be irrigated with a weak antiseptic solution through a double catheter. If the instrument is not readily introduced, it may be preceded by a laminaria tent or the use of an Ellinger dilator.

Any severe application to the uterine cavity should be preceded by extensive dilatation of the cervical canal, preferably with dilators. A set of Pratt's sounds with a central handle and a bougie on either end are very efficient. The direction of the canal should be known and care exercised to avoid puncture. Dilatation should be followed by curettement with a sharp curette the handle of which is hollow to permit of irrigation to wash away the débris as the curettement is done. This procedure may be followed by swabbing or injecting with tincture of iodine, a solution of the perchloride of iron, a strong solution of zinc chloride, silver nitrate, creasote, or carbolic acid. After application of any of these remedies the superfluous fluid should be removed by irrigation and the cavity lightly packed with iodoform gauze. The gauze as a tampon decreases hæmorrhage, favors closing up the vessels by plastic exudate, increases the activity of the circulation, by its presence as a foreign body promotes uterine contraction, and through its capillary action serves as a drain. It should be removed at the end of three days, and may be renewed after irrigation of the uterine cavity, or the patient may subsequently be treated by vaginal irrigation.

This treatment should be followed by no elevation of temperature; should it occur the gauze should be removed and intra-uterine irrigation at once given. If the external os is small, a crucial incision should be made prior to the dilatation, otherwise it will contract and again interfere with free drainage, which it is exceedingly important should be maintained.

Snegiroff advocates the use of steam, at a temperature of 100° C., in the treatment of endometritis. It produces cicatricial cauterization in the mucous membrane and when prolonged gives rise to a burn. In chronic catarrhal endometritis, he says, this procedure should be applied energetically. The apparatus consists of a receiver warmed with an alcohol lamp, provided with a thermometer. Steam passes from the receiver through a rubber tube into which is fastened a

Chase of Brooklyn, as a local application uses iodoform, glycerin, and iodine in equal quantities. He says that probably one of the best agents is a few drops of iodine and glycerin in equal quantities: iodine is antiseptic, stimulating, alterative, and promotes absorption. Another valuable remedy is aristol dissolved in 10 per cent. solution of albolene. He asserts the danger in the use of instruments is not so much from traumatism as from sepsis. Sponge tents should never be used, as they involve a great risk of injury to the cervical tissues and to septic infection. Any abrasion of the cervical tissue should be touched with pure carbolic acid.

The treatment of metritis with hemorrhage as a symptom may be divided into palliative, for relief of the bleeding, and curative. The patient should be kept absolutely at rest, prolonged vaginal injections of hot water given; ergot is of but little value; it may be given with more advantage in combination with hamamelis and cinnamon as follows :

R. Ext. ergot fl., f 3j (30.0) ;  
 Ext. hamamelis fl.,  
 Tr. cinnamoni, āā. f 3ss (15.0).—M.  
 S. A teaspoonful may be taken every two or three hours.

Fluid extract of hydrastis is sometimes efficient in 20-drop to drachm doses. Falk recommended, and Czempin has given, hydrastin, the active principle of hydrastis, in  $\frac{1}{4}$ -grain doses every six hours with marked benefit. Dilatation of the cervix or the use of a laminaria tent will stop the bleeding temporarily; more effective would be packing the cervical canal with iodoform gauze. The latter is more effective than vaginal tampons, and the gauze packing exercises a direct influence upon the diseased mucous membrane. In persistent and obstinate bleeding, the uterine arteries may be ligated by passing a ligature through the lateral vaginal fornices without incision, or better, with an incision, passing the ligature so as to secure the uterine arteries. The best hæmostatic, at the same time curative in character, is the use of the curette. It should be used as soon as possible, followed by injection of perchloride of iron and irrigation of the cavity. In rare cases we have hæmorrhage of so persistent a character that it is necessary to resort to either the removal of the ovaries and thus the establishment of the artificial menopause, or do a vaginal hysterectomy to remove the source from which the bleeding occurs.



In chronic metritis with severe pain the use of local bleeding, scarification, and puncture is followed by tincture of iodine and a glycerin tampon. Tampons may remain four or five days if a little iodoform has been added. Hot douches are of value, particularly where complicated by perimetritis. Massage is a very efficient agent in treatment of such cases, particularly when the uterus is fixed by perimetritic adhesions. In cases in which the cervix is very painful, causing distress in sitting and walking, much relief can be afforded by amputation of the cervix. The removal of a portion of tissue, the rest in bed, the alterative changes which take place, will result in decrease in the size of the uterus and the unpleasant symptoms are not infrequently entirely removed. This amputation should be done with a knife or scissors and the parts accurately brought into apposition so that the least amount of cicatricial tissue will result. Where the inflammation is complicated by extensive laceration of the cervix, with eversion of the lips, and a plastic exudate fills up the fissures, the best method of procedure will be to either amputate the cervix or remove the indurated tissue, freshen the edges of the fissure, and unite the surfaces by sutures. In performing this operation it is exceedingly important to so accomplish it that a good broad surface is left for the future os, otherwise contraction of the cervical canal takes place, defective drainage, and the development of diseased conditions extending into the tubes, ovaries, and peritoneal cavity, necessitating a serious and sacrificial operation.

Inflammation of the uterus in some form is common to all ages. It is frequently seen in girls of the ages of twelve to sixteen, when it produces menorrhagia, erosion of the external os, erosion and eversion of the lips, resembling a laceration of the cervix. Adenoid vegetations are found in the cervical canal (Mundé). The hypertrophic mucous membrane should be excised, the endometrium curetted, and if eversion is marked, the edges of the lips pared and sutured.

**Senile Endometritis.**—In the aged a muco-purulent discharge often follows the climacteric, which causes erosion of the lips of the cervix and the vault of the vagina. This condition may follow operations to artificially establish the menopause. It is usually readily cured by the use of a solution of silver nitrate ( $\frac{1}{2}$  to 1 drachm to the ounce). The use of the curette followed by the solution just named or one of chloride of zinc is advisable.

#### INFLAMMATION OF THE UTERINE APPENDAGES AND OF THE PERITONEUM.

The existence of inflammation in a Fallopian tube does not necessarily indicate the presence of coexisting trouble in the corresponding ovary, surrounding peritoneum, or the reverse, but they are

so frequently associated that it seems more convenient to consider them together. Inflammation extends from the uterus to the pelvic structures in one of three ways: first and most frequently, by the continuous surface lining uterus and tubes; second, through the blood-vessels; third, by the lymphatics. The extent of involvement, and the destructive influence of the disease are dependent upon the activity of the infecting poison and the degree of resistance of the tissues of the infected individual. Infection and disease of the pelvic structures may occur without infection from the uterus being responsible, as the intestinal canal, and more rarely the urinary tract may present the avenue by which it finds entrance. Diseases of the right tube and ovary are not rare occurrences from infection by a diseased vermiform appendix.

TREATMENT necessarily depends upon the character and extent of involvement. Our constant aim should be the preservation of life and restoration to health with the least possible sacrifice of organs and disturbance of their functions. To accomplish this we must be on the alert and ready to attack the encroachments of disease promptly and boldly.

Acute inflammations of the pelvis should be combated by rest, saline laxatives, hot vaginal and rectal douches, the continuous use of the ice-bag over the abdomen, early uterine curettement and gauze-packing, prompt incision and drainage of the broad ligament or retro-uterine cul-de-sac (Henrotin), breaking up exudate or adhesions, packing with gauze in order to afford pelvic drainage. The uterine gauze may be removed in forty-eight to seventy-two hours; that from the pelvis in ten days (Pryor).

The early application of this treatment may anticipate and avoid suppuration. The resulting adhesions and fixation may subsequently be overcome by the judicious exercise of pelvic massage and the use of glycerin tampons. Non-suppurative inflammation with fixation of the pelvic organs may be similarly treated, or by breaking up adhesions by means of a free incision through the posterior vaginal fornix.

Retro-uterine adhesions and those binding down the ovaries and tubes may thus be separated. Such a procedure is far more rational than that suggested by Schultze to drag the rectum from the posterior surface of the uterus by introducing two fingers into the former organ, or that of Sims to drag away the uterus by the introduction into its canal of a bougie. Neither procedure affords an opportunity to discover the extent of, nor the means to combat, a resulting injury.

Extension of inflammation into the tube produces a salpingitis, perisalpingitis, a sealing up of its abdominal end, a collection of serum and a resulting hydrosalpinx; the formation of pus, a pyosalpinx,



or extravasation of blood, or even hæmorrhage, a hæmatosalpinx, according to the virulence of the poison and resistance or want of resistance in the infected individual. The ovaries may be infected by direct passage of septic germs into an ovary rendered vulnerable by a recent rupture of its Graafian follicle or the pressure of a corpus luteum, or an infected tube, becoming adherent to a cystic ovary; subsequently through pressure-absorption a communication may be caused between them and thus cause a tubo-ovarian abscess. Tubal or tubo-ovarian cysts may be comparatively free from adhesions or be firmly fixed. Purulent collections are generally associated with extensive pelvic inflammation. Large collections generally result in rupture of the tube and the formation of an abscess in the broad ligament, or the pus may be encysted in the retro-uterine space.

It should be well understood that not every case of pelvic inflammation demands operative procedure. In rest, saline purgatives, hot douches, glycerin tampons, counter-irritants, and pelvic massage we have measures capable of restoring many such patients.

The existence of the severer forms of pelvic trouble does not absolutely demand sacrificial operations. As has already been suggested, early resort to vaginal incision and drainage may prevent suppuration, and abort a threatened severe and destructive inflammation.

With the advent of suppuration, Nature endeavors to bar the way to infection of the general peritoneal cavity by plastic exudate, which glues together the viscera. To operate upon a large pus-collection by abdominal incision means that the guards which Nature has so laboriously provided shall be effaced, that the general peritoneum shall be soiled by the removal through it of the pelvic pus. It would seem the wiser course to secure evacuation through the vagina. In some cases this will be found comparatively easy, as the collection, where it is encysted in the posterior cul-de-sac, may impinge upon the vagina, or it has filled up the broad ligament. In other cases it may require considerable dissection between the folds of the broad ligament, pushing to one side ureter and uterine artery. In all drainage operations it is important that no mere tapping of the collection, but a free incision shall be made. Conservation of function and structure has been announced as the guiding principle of the modern surgeon in the treatment of pelvic inflammation. But in cases in which the destructive influences have rendered the retention of the ovaries and tubes inconsistent with restoration to health, the question arises, What shall be done with the uterus?—the organ in which the infection developed and from which it extended—an organ whose functions are secondary to those of the ovaries, and in which changes are produced by the pathological process which will render it a source



of numerous local and reflex phenomena following the artificial menopause induced by the removal of the appendages.

#### REMOVAL OF THE UTERUS.

The recognition of these secondary manifestations led Baldy to advocate the supravaginal removal of the uterus in abdominal section wherever the destructive process required the removal of both ovaries. The relief of some neurotic phenomena by removal of uteri *per vaginam*, in cases in which the appendages had been previously removed through the abdomen, induced Péan to advocate what he calls uterine castration wherever both ovaries and tubes are irreparably diseased.

Both parties appreciated the baneful influence produced by retention of a subsequently useless organ which had been the original source of infection, but the course of procedure was very opposite. For the *abdominal* operation it is claimed, first, that the field of disease is more accessible; second, that a more complete operation can be accomplished because sight and touch can both be exercised; third, that it enables the operator to retain the cervix to help round out the vagina; fourth, that the peritoneal cavity can be closed, decreasing the possibility of hæmorrhage and infection; fifth, that the danger of injury to the ureter, bladder, or intestine is less, and when produced is more readily repaired. The advocates of the *vaginal* procedure, claim, first, that it permits of exploration and evacuation of pus-cavities before the peritoneal cavity is opened, thus decreasing the danger of peritoneal infection; second, that uterus, ovaries, and tubes can be easily removed, and with less disturbance of intestinal adhesions; third, that drainage is with and not against gravity, and from the most dependent part of the abdominal cavity; fourth, that with careful procedure no necessity exists for more danger of injury to bladder, ureter, or intestine than in the abdominal procedure; fifth, there is no danger of such unpleasant sequelæ as abdominal fistula and ventral herniæ; sixth, convalescence is more rapid.

It cannot be denied that both procedures have a place: while the vaginal route decreases the frequent necessity for the abdominal procedure, it should not always supplant it. The indications for each procedure in inflammatory diseases may be briefly stated as follows: The abdominal operation should be preferred, first, in unilateral disease of the appendages where the mass is comparatively free and does not encroach upon the lateral or posterior vaginal fornix; second, in bilateral disease of long standing where uterus and appendages are firmly fixed, without any indication of large pus-collection. The vaginal may be judiciously elected, first, where either large unilateral or bilateral collections of pus evidently impinge upon the vaginal

walls, whether they be situated posteriorly or laterally; second, where bilateral disease so profound in character exists as to demand the removal of both ovaries and tubes. In weak, debilitated patients suffering from large collections of pus, the choice of the vaginal route does not necessitate the performance of a radical procedure. The condition of the patient may demand a palliative operation. The heavy load of infection is evacuated by a simple incision and with but slight danger to the patient. After the patient has had a chance to recuperate her weakened vital forces a radical operation may be done, through the vagina or by abdominal section as may seem best adapted to the individual case.

The removal of the uterus through an abdominal incision may be complete or partial. The latter is more frequently practised. The procedure is performed as follows: After the ordinary preparation an incision three or four inches long in the median line is made, the ovaries and tubes separated and brought out, using an aspirator to remove pus-collections, and carefully guarding the viscera and wound-surfaces with gauze packing to prevent soiling from rupture of an abscess. A ligature is introduced through the broad ligament and tied external to the tube and ovary. The ligament is cut between the ligature and a pair of forceps placed next to the uterus. The opposite ligament is treated in a similar manner. If properly introduced, these ligatures have controlled the ovarian arteries. A peritoneal flap is now turned down from the anterior uterine surface, and with it the bladder. One end of the ligature is carried through the base of the ligament, and when tied secures the uterine artery, first upon one side and then upon the other. The cervix can now be cut through, removing the major part of the uterus without fear of hæmorrhage. Should any bleeding occur, the ligatures may be again introduced to secure an additional section of the broad ligament. The use of a continuous ligature gathers the ligament up, and renders the entire surface more easily covered with peritoneum (Goffe).

In amputating the uterus, care has been exercised to leave a short flap upon the posterior surface. By a continuous suture of fine silk or catgut the peritoneal flaps are covered over the stump, rendering the operation a retro-peritoneal one. Having determined that hæmorrhage is controlled and the pelvis clean, the wound in the abdomen is closed.

HYSTERECTOMY complete is performed in a similar manner, excepting that instead of cutting through the cervix an incision is made into the vagina posteriorly and the cervix closely hugged with scissors until the entire organ is removed; any branches of the vaginal artery or unsecured portion of the uterine artery may be ligated separately or in mass. The peritoneum may be closed as before, previously

taking the precaution to pack lightly the raw surface below it with iodoform gauze.

**VAGINAL HYSTERECTOMY.**—In the removal of the uterus by the vaginal route we may employ either the ligature or the clamp. The convalescence and subsequent progress of the case will be more satisfactory with the former. It is exceedingly difficult, however, to prevent the infection of ligatures, which will be followed by discharge until they come away. Consequently the catgut ligature should be preferred. The clamp operation is the more rapid. The instruments required are four wide and one narrow-bladed retractors, three double tenacula, a knife, scissors, six clamp forceps, a dozen hæmostatic forceps, and a thermo-cautery. After exposure with the retractors the cervix is seized with a tenaculum, drawn down, and the vagina separated from the cervix by the thermo-cautery knife. The vagina and bladder are pushed off anteriorly and the vagina posteriorly until the peritoneum is reached. The latter can be more readily determined anteriorly by elevating the vagina and bladder by a retractor, while traction downward and backward is made upon the cervix. The peritoneum behind the uterus is opened and the surface explored, when adhesions may be carefully separated as high as the fundus, particularly if the organ is retro-displaced. When the organ is non-adherent the anterior peritoneum may be opened at once, and the uterus will then be retained only by the broad ligaments. The inferior portion of each ligament is secured by clamp forceps or a ligature and the uterine portion detached. The cervix can then be amputated, and the remaining portion rotated through the anterior fornix, bringing the fundus down. The presence of adhesions may have prevented the early entrance of the anterior cul-de-sac; the amputation of the cervix and dragging forward of the uterus permit this to be safely and expeditiously accomplished. Adhesions may be separated when close and firm, under the sight, at the expense of the uterine structure. The eversion of the fundus and separation of adhesions permit the exploration and separation of the left tube and ovary, after which the upper part of the ligament, including the ovarian artery, can be secured with clamp forceps or ligature and the ligament severed, which permits the uterus to be held by the one side. The right ovary and tube are now brought down, the ligament secured as above, and the uterus removed. The separation of the ovary and tube occasionally may not be so readily accomplished. To afford additional room in such cases the upper part of the ligament may be secured with smaller forceps, the uterus removed, and the ovary and tube then enucleated. As the appendage is drawn out a large forceps, or ligature, is made to replace the smaller instruments. In rare cases the tubes and ovaries will be so firmly fixed as to preclude their



removal, when they should be torn open and carefully packed. After completion of the removal, careful inspection should be made for hæmorrhage, the vagina and pelvis irrigated with hot salt solution, and the cavity packed. The gauze should be carried over the ends of the clamp forceps to prevent their injuring coils of intestine. The dressing is completed by covering the external ends of the forceps with gauze and cotton to avoid entrance of pathogenic bacteria. This dressing should be changed as frequently as it becomes soiled.

The clamps are removed at the end of forty-eight hours, the gauze in four to six days. A few hours subsequent to the removal of the gauze a vaginal injection should be given, and repeated twice daily, or oftener, according to the amount and character of the discharge. The sloughing of the tissue included in the grasp of the clamps will produce some odor. The latter may be lessened or removed by douches of sulphurous acid (1:30), electrozone, a strong chlorinated water (1:4), or a 10 per cent. solution of the lactate of silver. The patient may be permitted to leave her bed at the end of ten days to two weeks.

#### INFLAMMATION OF THE OVARIES.

Inflammation of the ovaries is called peri-oöphoritis when it affects the periphery, and oöphoritis when the structure of the organ is involved. It is also divided into acute and chronic. These conditions do not exist alone, but are a part of a more general disease.

Inflammation of the peritoneum called perimetritis involves, with the other pelvic organs, the surface of the ovary, causing adhesions slight in character, forming firm bands, or so extensive as to bury the ovary permitting it to be discovered only by enucleation. The more acute forms of inflammation are associated with general sepsis. The ovary in pregnancy is particularly vulnerable. Its larger corpus luteum is easily infected. The writer has seen the ovary infected, resulting in an abscess, without any apparent involvement of the tube. That the tube was the avenue for infection was evident from the presence of a portion of lymph upon the side of the ovary, and another of similar character in the tubal ostium. The disease may undergo resolution or may result in chronic inflammation or the formation of an abscess.

The treatment consists in rest, depletion by saline purgatives, application of an ice-bag, or, where the latter is badly borne, hot applications. Continuous high temperature associated with pelvic symptoms should be regarded as an indication for removal of the diseased organ. The chronic forms should be combated by judicious measures. The relief of pelvic congestion, the exercise of counter-irritation, and

administration of alterative remedies may obviate the necessity for operative interference.

The existence of such conditions should not be regarded as demanding an abdominal section. When displaced, the ovary should be pushed up and supported by tampons or a suitable pessary. The patient should be cautioned against lying on her back. Where the organs as a result of disease are enlarged, painful and sensitive, and the general health is breaking down, an incision should be made. This need not be done through the abdomen, but by way of the vagina. The operation, known as "anterior colpotomy," has been largely practised by Martin of Berlin. An incision is made through the anterior fornix of the vagina, pushing off the bladder until the peritoneum is reached and opened. The ovaries are easily drawn through into the vagina, excised, resected, or punctured as their condition may demand.

**Cystic ovary** is a consequent of chronic inflammation; the resulting hardening of the tunica albuginea causes it to rupture before the matured follicle with difficulty or not at all. A number of such cysts may be found in an ovary, producing so much hyperæmia of the pelvis as to lead to intractable uterine hæmorrhage. The latter symptom may be so marked and persistent as to demand the removal of the ovaries.

Tubercular inflammation, occurring in either tube or ovary, should be regarded as an indication for prompt excision of the offending structures. Complicated by extensive pulmonary involvement or destruction, any operative procedure must be considered of doubtful expediency, if not absolutely contraindicated. A judicious *conservatism* in the surgery of the pelvis will lead the operator to preserve organs whole or in part wherever opportunity affords. Human nature is so constituted that we prize in the highest degree that which is lost. Many apparently seriously diseased organs may be saved or restored to functional usefulness. The separation of adhesions will set free a healthy but otherwise worthless tube. Gersuny recently opened the abdominal end of a Fallopian tube which contained a large quantity of fluid blood and fixed in it the adjacent ovary. The woman, who had been sterile through a five months' marriage, conceived in two months.

#### PELVIC CELLULITIS AND PERITONITIS.

**Pelvic Cellulitis.**—The cellular tissue about the uterus, and in the broad ligaments, is particularly prone to inflammation as a result of sepsis. The infection may enter through the wounds of the perineum, vagina, or walls of the uterus. The lymphatics are generally

the conveyers, consequently there is lymphangitis, and without doubt inflammation, and not infrequently suppuration of the lymphatic glands.

In the treatment must be considered rest, the maintenance of nutrition, the use of tonics, application of cold or heat, early incision, and drainage where the involved structures are accessible.

**Pelvic peritonitis** is much more frequent, and may result from an extension of septic or gonorrhœal infection through the uterus and tube. Inflammation in the latter leads to occlusion of its abdominal end, when the peritonitis may be in the form of a perisalpingitis, or the inflammation may extend through the uterine walls. While the source of infection is generally uterine, it may result from infection through the intestine, from bruising of the rectum during labor, from the vermiform appendix, from the rupture of a tubal-gestation sac, and the escape of blood into the peritoneal cavity. Such a collection may become encysted.

The inflammation may be confined to the pelvis or become general. The suffering is more intense than in cellulitis, so that it may be necessary to ameliorate the distress by opium or morphine. The main dependence should be upon the frequent administration of salines until purgation is produced, thus depleting the congested peritoneum. The use of the ice-bag affords great relief. Early resort should be made to surgical procedure. The proper means must be adapted to the particular condition and has been discussed under the various operations already given.

#### INFLAMMATION OF THE URINARY TRACT.

**Urethritis.**—Inflammation of the urethra is generally associated with cystitis, of which it may be either resultant or cause. It may be produced by gonorrhœal infection or from traumatism—as from the use of the catheter. A painful form of urethritis is produced by the presence of a fissured or excoriated condition of the internal meatus.

The opportunities for the production of urethritis and cystitis through the use of the catheter are so frequent, the subsequent symptoms so marked, and the condition so obstinate, that it seems wise to consider the necessary precautions to adopt in catheterization in order to prevent its production. With the exercise of the *greatest care*, the frequent and long-continued use of the catheter is likely to cause an irritable condition of the urethra. The trouble is most frequently produced by want of cleanliness, for which the old method of introduction of the catheter by touch is mainly responsible. The catheter, the hands of the operator, and the vulva should be clean,



conditions which are incompatible with the practice of introducing the instrument without exercising the sense of sight. A glass catheter is the preferable instrument, as we can better see that it is clean. It may be boiled before using, or be kept during the intervals of its use in an antiseptic solution and scalded just before its introduction. Its surface should be anointed with sterile vaseline. The vulva and vestibule should be sponged with a warm antiseptic solution, the labia separated, exposing the external meatus, and the catheter carefully and gently introduced. The finger is held over the orifice of the instrument until a receptacle can be placed beneath it. After the urine ceases to flow the finger should again be placed over the orifice of the instrument before its withdrawal. This precaution retains the urine in the catheter and prevents the soiling of the external parts with urine.

Despite the precaution just given, urethritis is frequent from catheterization, hence wherever possible the patient should be permitted to void her urine without assistance.

The presence of urethritis may be combated by injections of (1 to 5 grains to the ounce) solutions of silver nitrate, zinc sulphate (2 to 6 grains to the ounce of distilled water), to which may be added  $\frac{1}{2}$  fluidrachm of ext. hydrastis; zinc chloride 1 per cent. solution may be of advantage.

Gommaerts advocates a 5 per cent. solution of aluminol; Villetti a 2 per cent. solution of ichthyol, five to six times daily, which is gradually increased to 5 per cent.

In long-continued disease, especially when complicated by a fissured condition of the internal meatus, the promptest and most effectual relief is obtained by forcible dilatation of the urethra.

Cystitis is produced by gonorrhœa, extension of urethritis, infection from dirty instruments, from exposure to cold, and from over-distention of the bladder. When a large quantity of urine has been retained, the mucous membrane becomes anæmic from the great pressure. The complete evacuation of such a bladder would result in a sudden hyperemia of its mucous membrane, which causes violent inflammation. Not unfrequently such cases will shed the entire mucous membrane, either in shreds or as a complete cast of the bladder. Cystitis is sometimes simulated by functional diseases of the bladder. In the former the urine will be cloudy, filled with mucus, phosphates, shreds of tissue, epithelial cells, and blood- and pus-corpuscles; in the latter it is generally clear.

The treatment consists in keeping the urine bland and non-irritating by a carefully regulated diet. All acid articles and highly seasoned foods should be excluded. In severe cases an exclusive milk diet should be advised. Large draughts of saline or ferruginous water

should be given. Such remedies should be administered as will render the urine alkaline or non-irritating. The bromides will often give relief. A very efficient prescription is:

R. Ammon. benzoat.,                    ℥iij (12.0);  
       Tr. hyoscyami,                    fʒiiss (6.0);  
       Ext. buchu,                    āā. ʒij (60.0).—M.

Sig. A teaspoonful in water four times daily.

The bowels should be freely moved daily. Locally the bladder should be kept clean by irrigation through a double catheter with large quantities of hot normal salt solution, or some of the various local remedies which were advised for urethritis.

In obstinate cases the urethra should be dilated and the interior of the bladder carefully examined with the endoscope or urethral speculum. Local patches of abraded mucous membrane, ulceration, or papillary growths may be recognized and be treated locally. Silver nitrate (1 drachm to the ounce) applied on a small piece of cotton is efficient. The bladder should be immediately filled with a salt solution to neutralize the silver.

The patient may be placed under an anæsthetic for the necessary dilatation, or where the speculum has been previously used it may be reintroduced by previously swabbing the urethra with a 10 per cent. solution of cocaine. Mann has directed attention to the fact that a cystitis is often kept up by an attack of severe ureteritis. In such cases the orifices of the ureters will be noticed to be prominent and excoriated.

Edward Reynolds says that no diagnosis can be considered satisfactory unless the bladder is well dilated; when the dilatation is small, systematic inspection is prevented by the limitation of the field of vision. Small folds exist which are capable of hiding small lesions, and the trigonum is obscured by a small layer of urine.

He inserts into the urethra a pledget of absorbent cotton saturated with a 20 per cent. solution of cocaine and then dilates it to admit a No. 13 or 14 cystoscope. This is repeated at one or two more visits, after which a No. 12 cystoscope can be passed without pain. The knee-chest position affords the best dilatation of the bladder, but the trigonum is difficult of access and the position is uncomfortable for the patient. The position advocated by Kelly, in which the pelvis is elevated, is more comfortable, exposes the trigonum better, but affords less dilatation. The urine is more in the way. The Sims position is more comfortable for the patient, and midway between the positions already considered in the amount of dilatation and inconvenience experienced from the urine. The patient should be placed first upon one

side and then upon the other, in order that the entire field shall be exposed. The anterior vesical wall is difficult if not impossible to fully expose, but it is rarely the seat of exclusive disease. The trigonum is generally the part most seriously affected.

**Ureteritis.**—This condition is characterized by the symptoms of cystitis, with pain extending toward the corresponding kidney. By vaginal examination (Sänger) the ureter can be felt as a thickened cord and extremely tender. It is palpated by placing the finger behind the cervix and drawing it forward, when the ureter will be felt to roll under the finger. Kelly has advised a linen woven catheter by which the ureter can be explored and irrigated. In addition to affording facility for treatment of disease of the ureter, it is valuable in determining the condition of each kidney, its activity and the character of its secretion. The procedure affords an opportunity to carry the treatment to the pelvis of the kidney. For inspection and treatment of the bladder and ureters Kelly suggests the following instruments: a female catheter, several urethral dilators, a series of specula with obturators, a common head-mirror and lamp, argand burner, or electric light, long delicate mouse-toothed forceps, suction apparatus for completely emptying the bladder, a ureteral searcher, ureteral catheter without handle, and several bran-bags or an inclined plane for elevating the pelvis. For a first examination the patient is given an anæsthetic. The bladder is emptied by a catheter. The urethra should be dilated with graduated bougies, up to 12 mm., which can be accomplished with a but slight external rupture. A speculum of the same size is introduced and its obturator removed. The patient's hips are elevated upon cushions or an inclined plane to the height of 20 to 40 cm. (10 to 12 in.) above the table. Light is reflected into the speculum by a mirror from an argand lamp. Where the latter cannot be secured, a candle can be made to serve the purpose. The introduction of the speculum in this position leads to the bladder being ballooned by the entrance of air.

All parts of the bladder may be inspected by moving the speculum in different directions. By elevating the handle of the speculum the base of the bladder and the inter-ureteric ligament is exposed. Turning the speculum 30° to one or the other side, the orifice of the ureter is observed as a dimple, a little pit, in inflammatory cases as a round hole in a cushioned eminence, or as a V with its point directed outward. It may be seen to discharge urine in spirits, or give exit to pus or blood. The surface should be carefully sponged with a hot boric acid solution before the introduction of the catheter. The catheter may be left in place for an hour or more. The urine which accumulates in the bladder necessarily represents the other kidney. In this way the kidneys may be isolated and the secretion of both studied through the



introduction of the one instrument. With the long catheter the entire ureter can be explored and the pelvis of the kidney irrigated.

FIG. 290.



Harris's Instrument.

Harris of Chicago has devised a double catheter by which the bladder is divided into two receptacles and the urine thus secured from the kidneys separately.

## MALFORMATIONS, TRAUMATISMS, AND OBSTETRIC LESIONS.

### MALFORMATIONS OF THE GENITAL ORGANS.

THESE may be congenital or acquired. Many of these conditions are of interest from a diagnostic standpoint, but present no new phases which entitle them to our consideration.

*Atresias* and *fistulae* are of special interest.

*Atresia* may occur at the hymen, in the vagina, and at either the external or internal os in the uterus. The effect of the lesion will differ according to its situation. Associated with a normal condition of the other organs it may result in retention of the menstrual blood and of mucus in the vagina (*hæmato-colpos*) or vagina and uterus (*hæmato-colpometria*) or in large collection the tube may also be distended (*hæmato-colpo-metrosalpinx*); when the obstruction is situated in the cervix the collection occurs in the uterus and possibly also in the tube.

The danger of sepsis in operation upon such collections formerly

led to the advice that the tumor should be opened by a mere puncture and the contents should be permitted to escape drop by drop. The possibility of rupture of a distended tube still leads many to advocate the slow evacuation of the pus-collection. The writer would advocate the evacuation of the collection by a free incision and thorough irrigation of the cavity with a mild antiseptic. The cavity should then be packed with iodoform gauze. The packing should be removed at the end of forty-eight hours. Drainage by rubber tube may follow the removal of the gauze. Subsequently difficulty may be experienced in maintaining the opening. Such an artificial opening, where it occurs in the vagina, may be prevented from closing by directing the patient to wear for a stated period each day a glass plug. Narrowing of a limited portion of the vagina may be remedied by one or two vertical incisions through the stricture to its base, and uniting the surfaces by sutures parallel to the incisions, which will widen the narrowed canal. In atresia of some length, after incision, flaps of mucous membrane may be dissected up and carried through the constricted portion to form a new vaginal canal. In *absent vagina* we have the choice between an operation to form a vagina or the removal of the ovaries, and possibly the uterus, where the latter is filled with fluid. When we consider the difficulty of maintaining a vagina and the danger following a pregnancy, the latter procedure would seem the more advisable. Collections of fluid in one side of a double uterus or vagina offer difficulties in diagnosis. The treatment does not vary from that already described.

*Fistulæ* are generally traumatic, resulting from injury during labor. The fistulous openings between the neighboring viscera and the vagina are those between the genital and urinary tracts, four in number, the urethro-vaginal, vesico-vaginal, vesico-uterine, and uretero-vaginal. Those between the genital and intestinal tracts are ano-vaginal, recto-vaginal, and entero-vaginal. The general treatment of fistulæ has been discussed in the earlier volumes. Small fistulæ may be closed by flap-splitting operations. Thus, a trap-door flap may be lifted up, the opening closed by eye-silk or small chromicized catgut, and the flap stitched over it. In large fistulæ a flap-splitting operation will often permit the opening to be closed without any sacrifice of tissue. In very large fistulæ, where a good part of the anterior wall is destroyed, ordinary measures are futile for closing. The traction will be so great that the united tissues tear out. Such a fistula may be closed by transplantation of the bladder-wall (Bardenheuer). The patient is placed in the Trendelenburg posture, suprapubic cystotomy is done, and the bladder-wall dissected from the peritoneum and uterus until the fistula is reached. Adhesions and cicatrices are separated, the edges of the fistula are freshened, pressed

together with the finger in the wound, and from the suprapubic opening silver-wire sutures are introduced, bringing them out upon the vaginal side. The catheter should be used every three hours.

A **uretero-vaginal fistula** may be closed by dissecting up the orifice, turning it into the bladder, and suturing the vaginal surface in such a way as not to compress the ureter. It is probable the more certain plan would be to open the abdomen, pick up the affected ureter and turn it into the bladder, doing what is known as a uretero-vesical anastomosis (Boldt).

**Entero-vaginal fistulæ** are most effectively closed by abdominal incision. The opening in the intestine closed, the vagina no longer demands consideration.

**Traumatisms.**—Injuries of the vulva and vagina are obstetrical and non-obstetrical. The latter are less frequent and arise from perforation by falling upon some body, or are injuries of coition. The treatment should be immediate and directed to the relief of the injury.

#### OBSTETRIC LESIONS.

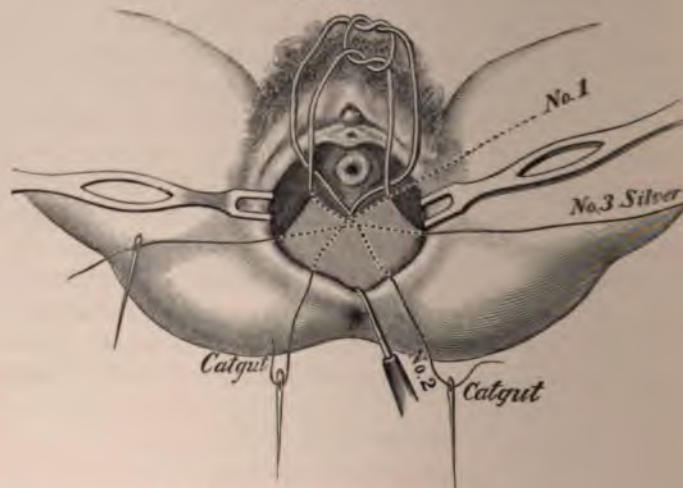
Obstetric lesions are generally lacerations of the perineum during the progress of labor. Laceration of the perineum may be very slight or quite extensive, involving the sphincter ani and the recto-vaginal septum. Where possible, every laceration should be immediately sutured. If the labor has been very long and the vulva is frayed and bruised by repeated and long-continued attempts to deliver with forceps, immediate closure is inadvisable, as the loss of vitality in the tissues will probably cause sloughing of the sutured surfaces, thus endangering the development of sepsis where drainage is obstructed by sutures. In the worst cases, however, an attempt should be made to secure control of the bowel by union of the recto-vaginal septum and of the sphincter ani, leaving the remainder of the perineum to be repaired by a secondary operation. Dr. Watkins, in Volume III. of this SYSTEM, has so accurately described his method of anterior colporrhaphy and the ordinary operations upon the perineum as to leave but little to be added.

Outerbridge modifies Emmett's operation by greatly shortening it. He uses but three sutures to coapt the denuded surfaces (Fig. 291). The upper suture is medium-sized catgut, ten or twelve inches long, with a needle at either end. One needle is imbedded in the crest and continued along the upper line of the denudation, coming out at the right upper angle in the undenuded tissue. The other is continued in the same manner to the left, coming out at the left upper angle. This suture is not tied, but the needles on either side are thrown over the symphysis temporarily. The next suture is of silver, and the needle is imbedded one-quarter of an inch above the denuded tissue, midway



between the upper and lower points of denudation, or, in other words, at the highest point of denudation upon the left side of the labia, and

FIG. 291.

Outerbridge's operation (*Medical Record*).

proceeds from left to right to a corresponding point upon the latter side, being throughout thoroughly imbedded. The upper suture is now tied, care being exercised to approximate the tongue or central portion and the right and left angles. One of the needles of this suture is then passed downward and outward from the central point under the denuded tissue and brought out at one side of the labia, about half an inch above the lower point or angle of denudation; the second needle is passed in a similar manner to the opposite side. This suture should now be tied, exercising care to draw it tightly. This completely closes the lower angle of denudation. The silver wire is next to be twisted. Occasionally one or two superficial sutures will be required.

This operation lifts the posterior wall up against the anterior, is easily done, and does not produce sloughing. But one suture will require removal. The writer, in complete laceration or in those lesions in which the sphincter is weakened, splits up the perineum and brings the surfaces together with No. 00 chromicized catgut, which is introduced as a continuous and buried suture. The first aim is to bring in contact the divided or torn ends of the sphincter ani muscle, and second, to draw into the median line the ends of the ischio-cavernosa muscle. The remaining denuded surfaces are brought together and covered with a row of catgut sutures in the skin. This operation makes no painful traction upon the wound-surfaces and consequently is not attended with much pain. By the use of the

chromicized catgut the wound is sure to be kept in contact sufficiently long to secure firm union, while the patient is spared the anxiety regarding the removal of the sutures.

In more or less complete lacerations the operation should be preceded by free purgation, restriction of diet for two days to animal broths, and rest in bed. She should remain in bed for fully two weeks after its performance, be restricted to animal broths for one week, and should not be allowed the use of milk during convalescence. The bowels should be evacuated upon the third day and daily thereafter. The marital relation should not be resumed for six weeks.

**Laceration of the Cervix.**—The effect of laceration of the cervix will depend upon its extent. The slighter lacerations are of but little moment except as indicating the importance of treating the accompanying endometritis. Such lesions should not be considered as indicating operative procedure, for the decrease in the size of the cervical opening obstructs drainage and increases the danger of extension of disease to the deeper pelvic structures. The deeper lacerations, associated with eversion and hypertrophy of the mucous membrane, call for operative relief. The method of procedure will be dependent upon the complicating inflammatory lesions. A cervix with a deep unilateral or bilateral tear in which there is but little induration of the lips, or eversion of the mucous membrane, may well be submitted to trachelorrhaphy. In laceration with hypertrophy of one lip, or eversion of hypertrophied mucous membrane, Schroeder's one-flap amputation of the cervix is the preferable procedure. The procedure should be chosen which will best remove the diseased structure and subsequently afford a good cervical canal for vent to its discharges. Dührssen advocates a flap-splitting operation upon the cervix by which the necessary denudation is accomplished without the sacrifice of tissue. Where the laceration extends through the cervix into the cellular tissue, a cicatrix results which draws the cervix toward the affected side. Martin overcomes this displacement by a circular incision upon the side of the uterus. Sutures are introduced parallel to the incision, which correspondingly increases the length of the lateral vaginal fornix. Hæmorrhage following either trachelorrhaphy or amputation of the cervix may be arrested by passing a suture deeply upon the side from which bleeding occurs, so as to obstruct the uterine artery.

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## DISPLACEMENTS.

THE uterus may be displaced in any direction. The most important displacements are prolapsus, the retro-displacements, and ante-

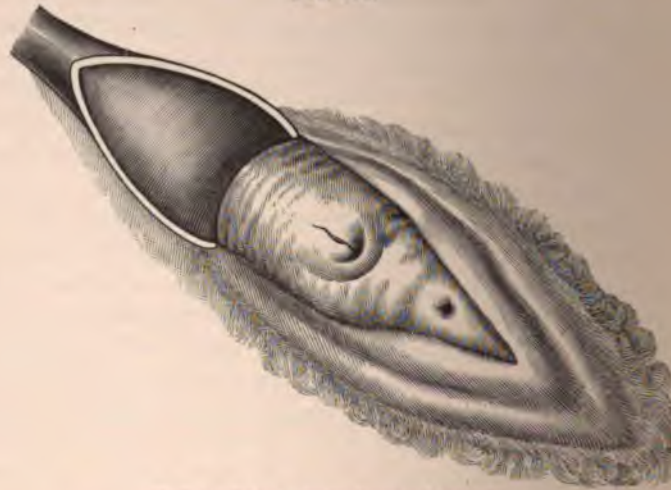


flexion. *Anteversio* is a symptom dependent upon any cause which increases the weight of the organ. Its treatment, then, is that which is applicable to its cause.

*Anteflexio* may be congenital or acquired. The former exists in those cases in which there has been defective development, and the organ retains its puerile form with a cervix disproportionate to the body. The acquired anteflexion results from cold or exposure during menstruation, followed by inflammation; from inflammatory changes subsequent to parturition or abortion; or, from the presence of growths within the uterine walls. The displacement interferes with the proper performance of the functions of the organ, hence dysmenorrhœa and sterility result.

TREATMENT consists in relief of pelvic congestion, the use of hot vaginal douches and glycerin tampons, regulation of the bowels, and the exercise of proper hygiene. In the less severe forms the uterus may be dilated, curetted, and packed with gauze. The resulting exudation of the walls leads to an improved position and better drainage. If the flexion is situated in the middle or lower cervix, splitting the posterior lip will straighten the canal, afford relief during menstruation, and increase the probability of fecundation. The incision, however, inclines to close and contract. Dudley advises to split the posterior lip beyond the utero-vaginal attachment (Fig. 292). The sur-

FIG. 292.



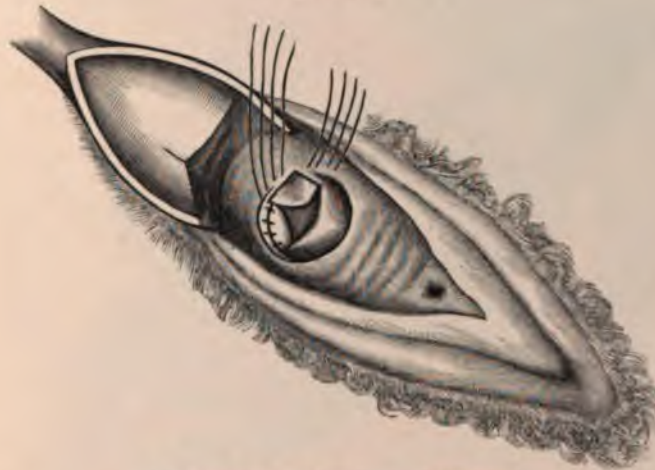
(E. C. Dudley, in *Amer. Journ. of Obstetrics*.)

faces are held apart by tenacula and the incision deepened, especially upon the cervical side, with the knife. The surfaces are then folded in and (Fig. 293) secured with silk-worm sutures, uniting the uterine and vaginal mucous membranes. The anterior lip of the cervix



is amputated (Fig. 294) and closed with transverse sutures which push back the cervical orifice (Fig. 295). In flexion situated in the upper

FIG. 293.



(E. C. Dudley, in *Amer. Journ. of Obstetrics*.)

third of the cervix, Vuillet dissects off the bladder (Fig. 296), makes a vertical incision upon a grooved director (Fig. 297) from above the

FIG. 294.



(E. C. Dudley, in *Amer. Journ. of Obstetrics*.)

point of flexion to the intervaginal portion of the cervix (Fig. 298); from this point an incision is carried transversely around the cervix, ending posteriorly. This flap is turned up and sutured into the cer-

vix, increasing the size of the canal. The vaginal wall is sutured with catgut.

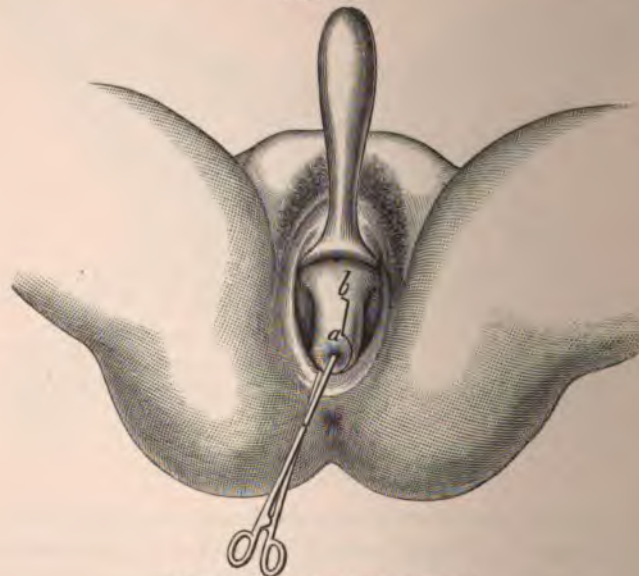
FIG. 295.



(E. C. Dudley, in *Amer. Journ. of Obstetrics*.)

The recognition that the flexion corresponded to the shorter wall led Nourse to devise an operation to shorten the long wall. He

FIG. 296.



(Vuillet, in *Ann. Univ. Med. Sciences*.)

splits the uterus into halves and slightly above the flexion makes traction upon the long wall, and sutures the incision on either side.

FIG. 297.



FIG. 298.



(Vuillet, in *Ann. Univ. Med. Sciences*.)

The longer lip may be amputated or permitted to contract and heal by granulation. The operation should be immediately preceded by a curettement and disinfection of the uterine canal, otherwise there may be danger of pelvic infection. The operation is quite effective in either anterior or posterior flexion.

**Retro-displacements** of the uterus are the most frequent form of malposition. They are divided into versions and flexion. The treatment of the two conditions varies but little. It is divided into—

1. *Replacement.*

2. *Maintenance in normal position.* The retention of the uterus in a replaced position is accomplished—

- (a) By mechanical means.
- (b) By massage.
- (c) By operative procedure.

The first division, the replacement of the uterus, may be accomplished—

- (1) By combined manipulation.
- (2) By instruments.
- (3) By position.

As these methods of procedure have been described in an earlier edition, it is unnecessary to discuss them further than to discountenance the use of the intra-uterine sound or repositor. These instruments cannot accomplish the purpose, however carefully handled, without more or less traumatism of an organ whose position necessarily renders it irritable and susceptible to the onset of an inflammatory attack.

**PESSARY.**—We cannot regard the introduction of a pessary as a



justifiable procedure unless the uterus has been carefully replaced. The use of a pessary without complete replacement is prone to convert a version into a flexion and to aggravate the trouble. Pessaries should not be worn when there is any fixation of the uterus. Adhesions incline to draw back the fundus and produce discomfort and suffering.

MASSAGE is an agent the value of which has not been appreciated in pelvic diseases. Recent adhesions may be readily overcome and the pelvic distress relieved by its use. Careful selection should be made of cases. The presence of collections of liquid, whether pus, blood, or serum, contraindicate its practice. The method of Schultze, as well as the operative procedures for fixation without opening the peritoneal cavity, is to be condemned. They are blind procedures, capable of much and serious injury without affording an opportunity to recognize and remedy it.

THE ALEXANDER-ADAMS OPERATION has a limited application. It is contra-indicated when there are any perimetritic adhesions, and we have no means of absolutely determining their absence. Many modifications of the operation have been introduced. Newman makes his opening over the internal inguinal opening; he claims for this modification that the ligament is drawn straight out, with greater ease, and that it requires but little dissection. Edebohls lays open the canal throughout its entire length. The ligament is fastened by silk, silk-worm-gut, catgut, or silver wire. The superfluous portion is either cut off, folded up beneath the subcutaneous fascia, fastened by a knot to the opposite ligament, and buried in the incision connecting the two wounds, or the ends are pushed through the fascia and united by sutures.

VENTRAL FIXATION, or suspensio uteri, has the advantage over the preceding operation that it is applicable to any displacement; it requires but a single short incision and affords an opportunity to inspect and treat any disease of the pelvic organs. The most valid objection to it is that it has been provocative of trouble in subsequent gestation and parturition. This difficulty is probably overcome by exercising care not to make too broad a band of adhesion or include more than the peritoneum in the sutures fastening the uterus forward. This course, it is claimed, makes a long, slim band of adhesion. Two sutures of fine eye-silk are passed through the peritoneum and fundus, and are buried.

SHORTENING OF THE ROUND LIGAMENTS is practised from within the abdominal cavity. The middle portion of each broad ligament is sutured with a loop (Wylie), the centre of the middle portion is sutured against the side of the uterus (Dudley), or a suture is passed through the middle portion of one round ligament, though the ante-

rior surface of the fundus uteri and the opposite ligament, when it is tied, swinging the uterus forward (Mann).

Various procedures have been devised to fix the uterus to the abdominal parietes without opening the peritoneum. Baum of Kansas City dilated the uterus and passed to its fundus an instrument by which the organ was carried against the abdomen, and two needles armed with a silkworm-gut suture were thrust through it and the abdomen, between the points the skin was incised and the suture buried. King pushes the fundus against the parietes, makes an incision to the peritoneum and introduces one or two sutures. Both procedures are blind and consequently to be condemned. Still more objectionable is the operation devised by Schucking, which consists in passing by a spring needle a suture through the fundus into the vagina and tying it. The operation brings the uterus into extreme ante flexion. Besides maintaining the uterus in an abnormal position, it endangers the ureter and bladder.

Several operations have been devised by way of the vagina. Mackenrodt made a vertical incision through the anterior vaginal wall, pushed up the bladder, opened the peritoneum, drew forward the uterus and sutured it to the vaginal walls. Where the uterus is held back by adhesions, it is not always easy to separate them through an anterior vaginal incision; the uterus has frequently been so injured in trying to bring it forward that hysterectomy was resorted to in order to complete the operation. The most serious objection to the procedure, however, is that it has been found to seriously interfere with the progress of subsequent gestation and parturition. Nearly as objectionable is the procedure known as vesico-fixation, in which the attempt is made to obliterate the vesico-uterine fold. Wertheim advocates drawing down, through the anterior colpotomy, each ligament and fastening it in the vaginal wound. The writer has been much pleased with the ease with which he could fasten the round ligaments to the anterior fundal surface through an anterior colpotomy, and is disposed to advise it in preference to the plan proposed by Wertheim.

Gottschalk operates through a posterior vaginal incision. It enables him to break up adhesions and renders the uterus movable. He then introduces a suture through the middle portion of the utero-sacral ligament and the side of the cervix, and a second ligature upon the opposite side. These ligatures tied, the cervix is drawn backward and upward.

In retroflexion with extensive adhesions, a posterior vaginal incision permits the adhesions to be broken up, the uterus brought forward, and the pelvis packed with a large quantity of gauze, which is permitted to remain nearly a week (Pryor).

**Prolapsus Uteri.**—We do not consider it necessary to discuss the various tentative and radical procedures which have been given in previous editions, but will call attention to Dudley's lateral colporrhaphy. It consists in denuding a surface, beginning at the side of the uterus and extending along the lateral surface of the vagina to the vulva. The sutures are so introduced as to raise up the long posterior vaginal wall. While this operation retracts the vagina and holds it for support to that wall which is least likely to give way, it is yet at fault in that it leaves a heavy uterus free to be subsequently driven through the narrowed canal and the displacement to become re-developed.

Baldy advocates opening the abdomen, doing supravaginal hysterectomy, and securing the stump from displacement by a ligature on either side from the broad-ligament stump.

Noble suspends the cervix from the abdominal parietes.

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### NEOPLASMS; TUMORS AND CYSTS.

**Neoplasms.**—New growths are benign and malignant. Those of the vulva have been fully described. The vagina rarely is the site of origin for anything more than small cysts.

The uterus is the source in which a variety of growths known as *fibroids* frequently originate. They may be multiple or single, and vary greatly in the character of their symptoms according to the situation. The submucous and interstitial are prone to the production of hæmorrhage, the subperitoneal may be unsuspected until accidentally discovered. Small subserous growths may exist for years without the production of symptoms. It is better that the patient should not be informed of their existence, as the knowledge unnecessarily adds to her worryment.

The treatment is medical, electrical, and surgical. The medical treatment has been given; it is capable of delaying the progress of growths, decreasing hæmorrhage, and, where the growth is favorably situated, expedites its extrusion from the uterine wall, either as a submucous or subperitoneal tumor.

**ELECTRICITY.**—It was once claimed that this agent was efficient in curing not only symptomatically but radically. Practice, however, has demonstrated that while it is capable of affording relief from pain and hæmorrhage, it has but little if any influence in reducing the size of the tumor.

While it has a beneficial influence in arresting hæmorrhage, and consequently is a valuable adjuvant where the condition of the patient is such as to preclude any operative interference, it is not so expedi-



tious or effective as many comparatively simple surgical measures. No better demonstration of the inefficiency of electricity in reduction of the size of fibroid growths should be required than the result in the Berlin clinics. Of 143 cases in which Apostoli's treatment was carried out, there was but one in which there was a radical cure, and that was in a tumor the size of a fist. In another, a tumor of the submucous variety was expelled from the uterus following intra-uterine galvanism. In 107 cases treated by Nagel and Mackenrodt no appreciable diminution in size was seen. All agree that for the relief of hæmorrhage and pain it was beneficial in 60 to 70 per cent., but relapses were frequent among those relieved, while 30 to 40 per cent. were unrelieved or were made worse. The symptom of hæmorrhage may be much more rapidly and permanently checked by the use of the curette and injections of iodine.

#### SURGICAL RESOURCES.

In the surgical procedures we find the most effective and rapid method of dealing with fibroid growths of the uterus. The method will depend, of course, upon the size of the growth, its situation and the amount of the uterus involved. The methods of procedure may be classified, according to the direction in which the mass will be approached, into the vaginal or abdominal. Under the *vaginal* we have dilatation of the neck, incision of the neck, curettage, myomectomy, ligation of the uterine arteries, and vaginal hysterectomy. By the *abdominal* we have castration, ligation of the ovarian arteries, myomectomy, enucleation, hysterectomy partial, hysterectomy complete. The vaginal route will be preferable in the submucous or interstitial varieties, where it is possible to enucleate the tumor and leave the uterus. It is also used in those cases of removal of the uterus where the organ is not too large to come through the vagina, or where it can be readily removed piecemeal. Dilatation of the uterus may be done for diagnosis, or exploration of the uterine cavity in cases of doubt in which hæmorrhage is particularly a symptom. Dilatation of the uterus in growths of some size which have become submucous, facilitates the extrusion of the tumor into the vagina or the more rapid separation of the tumor from the uterus. This condition also may be facilitated by an incision of the neck. In a tumor which is of considerable size, of the submucous variety, filling up the cavity of the uterus, the incision of the neck, weakening the resistance of the cervix, will facilitate the delivery of the mass. Incision also affords an opportunity to explore the uterine cavity, and in cases in which it is not deemed advisable to resort at once to operation, in which hæmorrhage is a symptom, it will permit of the incision of the uterine mucous membrane over the surface of the tumor, the consequent con-

traction of the blood-vessels and arrest of the hæmorrhage. Where hæmorrhage is a marked symptom, one of the most effective methods of its control is by the use of the curette. This should be preceded by dilatation of the neck in order that there should not be defective drainage and accumulation of fluid in the uterine cavity. The curettage brings about a renewal of the uterine mucous membrane, contraction of its blood-vessels, recovery of the health of the patient, and arrest of the symptom hæmorrhage.

**MYOMECTOMY.**—By this term we mean cutting off a fibroid. This is particularly applicable to fibroid polypi, which usually hang by a distinct pedicle. The removal of the fibroid, if it has a small pedicle, may be readily accomplished by seizing the tumor with a strong volsella and twisting it until the pedicle is torn off, or again, where it is larger and firmer, it may be removed by the use of the scissors. When the pedicle is cut through, it is well to seize the part and apply the Paquelin thermo-cautery to the base, which, while it prevents the danger of infection of this surface, also destroys the stump and decreases the probability of the development from it of another fibroid. Where myomectomy is done, removing a large mass from the uterine cavity, it is better after its delivery that the uterine cavity should be thoroughly irrigated, using for this purpose a normal salt solution, and then packing gently with iodoform gauze. The object of doing this is to prevent accumulation of fluid in the uterine cavity, which may undergo infection by the presence of pathological germs in the air, or which have been brought to it by the finger or instruments in the manipulation. This packing may remain in the uterus from three or four days to a week; when it is withdrawn the cavity should be thoroughly irrigated and a smaller packing introduced.

**LIGATION OF UTERINE ARTERIES.**—In tumors of moderate size, where a large amount of uterine structure is not involved, it may seem undesirable that so radical an operation as extirpation of the uterus should be performed. Indeed, it should be our purpose to save the structures whenever it is possible to do so. Franklin Martin has suggested the ligation of the uterine arteries through the vagina. An incision is made first upon one and then upon the other side of the cervix, partially encircling it; after cutting through the mucous membrane the cellular tissue is reached, the peritoneum is pushed backward, burrowing up into the broad ligament until the uterine artery can be distinctly felt. This is secured by passing a ligature about it, tying it firmly. The opposite ligament is treated in a similar manner. In cases in which hæmorrhage has been very profuse we may burrow further in the broad ligament on one side until the ovarian artery is reached and secured by a ligature, so that subsequently the tumor receives its nutrition only through the remaining ovarian artery. The



decreased nutrition necessarily results in arrested growth, if not in diminution of the size of the tumor. From a number of operations which have been performed by Martin and others very satisfactory results have been obtained.

**VAGINAL HYSTERECTOMY.**—Vaginal hysterectomy may be performed in all cases of fibroid growths of small size, whether single or multiple. The method of performance of this operation has already been described under the head of inflammatory diseases of the pelvis. The operation consists, after thorough cleansing of the abdomen, in an incision around the cervix through the vaginal mucous membrane, preferably by means of a thermo-cautery knife, as this decreases the amount of bleeding from the superficial vessels and at the same time affords better drainage, as the burnt surface does not heal up so quickly by granulation. After cutting through the vagina, the tissues are pushed off in front between the uterus and bladder until the peritoneum is reached, in a similar manner, posteriorly. Having reached the peritoneum a pair of clamp forceps are applied on either side, to secure the uterine arteries. The secured portion of the broad ligaments is cut off from the uterus and the cervix amputated near the level of the internal os. This permits the more ready rotation of the uterus, to bring out the fundus. If fibroid masses of considerable size are in the fundus of the uterus and are too large to permit the entire mass to be brought down, the capsule may be incised, the tumor enucleated, and a number of fibroids removed in this way. After rotation of the fundus and withdrawal of the ovary and tube, a pair of clamp forceps is applied upon the left broad ligament securing that portion not secured by the first clamp, the broad ligament is cut through, the opposite ovary and tube are then turned out and the clamp applied to the broad ligament external to them.

The subsequent treatment of the wound is similar to that which is practised in vaginal hysterectomy for inflammatory troubles. It is important, however, for the control of hæmorrhage that the clamp forceps should remain for a longer period than in the inflammatory cases; indeed, seventy-two hours would seem preferable, for the reason that the vessels are much larger and consequently there is increased tendency to hæmorrhage.

In fibroid tumors of considerable size we may still resort to the vaginal procedure, doing what is known as *morcellement*—the removal of the mass in pieces. For the proper performance of this operation it is necessary to have several double tenacula so that the parts can be held firmly without slipping, and a portion of the mass is seized with a double tenaculum and a piece of tissue cut out. Before the tissue is entirely removed another tenaculum can be inserted, and a tenaculum constantly be kept in the more solid tissue, so that the tumor may not



be displaced and thus render it difficult to again secure it. Hæmorrhage is controlled by seizing the blood-vessels in the capsule with a pair of hæmostats, or, as the dissection progresses and the pedicle or broad ligament is drawn down, the control of vessels may be accomplished in a similar manner to the performance of vaginal hysterectomy. With the completion of the removal of the mass the wound is also treated in a similar way. This operation is very popular with the French surgeons.

The *abdominal* procedure also enables us to cut off the blood-supply without the sacrifice of the organ. This operation, introduced by Byron Robinson of Chicago, consists in ligation of each ovarian artery, and after separating the broad ligament making a second ligation in the anastomosis of the ovarian and uterine arteries about midway between the internal os and fundus of the uterus. This cuts off to a large degree the supply of nutrition to the fundus of the organ and permits its subsequent reduction. This operation is fully as effective as the one formerly practised of castration.

CASTRATION is the ligation of each broad-ligament pedicle and the removal of the ovaries. This procedure, however, is not always effective in control of hæmorrhage. In some cases the hæmorrhage is just as great after the removal of the ovaries as before; these are cases, probably, in which the ligation only secures the ovarian branches to the ovary and tube and does not obstruct the ovarian artery. The passage of the ligature in such a way as also to include the round ligaments renders it more certain that the ovarian artery is included in our ligature.

MYOMECTOMY.—This operation is applicable to all those cases in which the tumor is more or less separated from the body of the organ by a pedicle or neck. In such cases the operation can be readily done with but little hæmorrhage and no severe constitutional effects. If the tumor is attached to the uterus by a broad base its wall may be incised and the tumor itself enucleated. The cavity thus formed, after being carefully trimmed and the shreds of tissue removed, may be closed by turning in its edges and using a continuous catgut suture. The peritoneum over the first row of sutures may be again sutured, making a thicker wall.

ENUCLEATION.—In many cases the growths may be enucleated and the cavity sutured with continuous catgut sutures, thus retaining a functioning uterus. The writer thus removed thirteen growths from one uterus, with complete recovery of the patient.

HYSTERECTOMY for fibroids is an operation which has been practised for quite a long period. The first operation was probably done by Burnham of Lowell, Mass. The later methods of procedure have rendered the operation of little danger, and consequently it is more

frequently practised. The operation may be done by bringing the stump composed of the cervix uteri out through the lower angle of the abdominal wound, in which it is fixed by the insertion of pins. It is then secured beneath the pins by a *serre-nœud* or the application of an elastic ligature, the peritoneum being stitched to that of the stump beneath the ligature. This procedure results in the separation by a process of sloughing of the external stump, which renders it exceedingly difficult to keep the wound aseptic and prevent suppurative processes in it. After the separation of the external portion of the stump the pedicle retracts, leaving a deep sulcus which must fill up by granulation, and the consequence is that we necessarily have a prolonged convalescence and a weakened ventrum which may result in subsequent ventral hernia. For this reason other methods of treatment of the pedicle or stump were urgently sought.

The operation as devised simultaneously by Eastman, Goffe, and Baer consists in ligation first of that portion of the broad ligaments containing the ovarian arteries, incision between the clamp forceps and the ligature, separation of the peritoneal surfaces, carrying a flap forward in front through the peritoneum, and a second posteriorly. A second ligature is applied on each broad ligament in such a way as to include the uterine artery. Having secured the patient against hæmorrhage in this way, the parts are separated and the tumor removed, making the incision through the stump at or below the external os. Having removed the mass and made sure that hæmorrhage is completely arrested we may proceed to the sterilization of the remaining cervical canal. This may be done by the introduction of the thermo-cautery, the use of carbolic acid, and if there is much space in the tissue above from which oozing is likely to occur, it may be packed with iodoform gauze, taking the precaution to pass its end through the cervix so that it may be removed by the vagina. The peritoneum should be stitched over the gauze so that the stump is entirely shut out from the peritoneal cavity, and we have consequently an extra-peritoneal treatment of the stump.

Where the cervix is large or taken up to a great degree by the tumor, complete hysterectomy will be preferable. In the performance of this operation ligatures are applied in a similar manner, the second ligatures at a sufficient depth to make sure that the uterine arteries are secured, then, making an incision through the posterior cul-de-sac into the vagina, the finger is introduced and the stump left by the previous removal of the fundus uteri is cut around and completely removed. After cleansing the vaginal surface it is united by sutures and the peritoneal surface closed, making the operation a clean one so far as the peritoneal cavity is concerned. This operation is fully as efficient, and the mortality no greater, than in partial hysterectomy.

In the removal of fibroid tumors there are special difficulties which demand particular consideration according to the situation of the growth. Not infrequently we shall find the growth situated in a broad ligament, compressing or displacing a ureter, so that the removal by the way we have just mentioned will be exceedingly difficult and greatly endanger the continuity of the ureter.

We may ligate both ovarian arteries in mass if practicable, then ligate the deeper portion of the broad ligament upon the free side, and tilt the uterus (Pryor), cut from one side to the other across the cervix (Kelly); the bladder having been previously separated we ligate the lower portion of the ligament, which includes the uterine artery, and roll out the tumor, having it connected only by the spread-out folds of the broad ligament, which can now be easily separated without danger of injury to any of the viscera. If the ovarian artery has not been previously secured it can now be ligated.

#### TUMORS OF THE TUBES AND OVARIES.

Fibroma of the tubes is rare; of the ovary, more frequent, but in less proportion than cystoma. The treatment is removal, but it does not differ from the operation of ovariectomy. The treatment of such tumors of the tube as pyosalpinx, hydrosalpinx, and hæmato-salpinx has already been described under the head of inflammatory diseases.

Tumors of the ovary are divided into large and small. The large tumors comprise the glandular and papillary, proliferating, and the dermoid. The small cysts are (1) the small residual cyst of Morgagni; (2) the follicular cyst; (3) cysts of corpus luteum; (4) tubo-ovarian cysts. The small cysts only demand treatment when they give rise to symptoms, which is much less frequently than is suspected. The treatment may consist in ovariectomy, or the resection of the ovary, saving as much of the healthy structure as possible.

The only treatment of large cysts is *ovariectomy*. In very large cysts, where the danger of shock is great, a few days' preliminary tapping may be done. The details of ovariectomy are given in Volume III. Occasionally an ovarian tumor will be found presenting adhesions of such a character as to preclude its removal. Such cases in the hands of experienced and skilled operators are exceedingly rare. When it is decided to retain the cyst, it should be opened, and its cavity gone over with the hand. Partitions should be broken down, the cavity irrigated with a normal salt solution, and subsequently packed with iodoform gauze. The opening in the cyst should be stitched to the abdominal parietes to prevent infection of the peritoneal cavity.

Dermoid cysts should not be tapped and particular care should be



exercised that the cyst does not rupture during removal, as its contents are exceedingly infectious.

**Broad-ligament Cysts.**—These growths should be removed. It is true that they sometimes disappear after an accidental rupture or a tapping, but the result is not sufficiently certain, nor can we always be so confident of our diagnosis as to render the treatment by tapping justifiable. The writer has recently seen a small cyst of this variety whose pedicle had become twisted and cut off the circulation, resulting in death of the tumor. The patient had had repeated attacks of right inguinal pain, simulating appendicitis and so diagnosticated.

In the removal of broad-ligament and intra-ligamentary ovarian cysts great care must be exercised not to injure the intestine, the bladder, and particularly the ureter. The latter will often be found closely adherent to the cyst-wall. Not infrequently it will pass directly over it and will be cut or torn unless the enveloping tissue is carefully examined.

Rupture of the ureter demands immediate attention, and various methods have been practised: extirpation of the kidney, ligation of the ureter, establishment of a urinary fistula, anastomosis with the colon (Van Hook), uretero-ureteral anastomosis (Kelly, Bache Emmett), or uretero-cystotomy (Novaro, Kelly, Krug, Penrose, Baldy). Removal of the kidney—in the duration of operation and the necessity for increased dissection—adds much to the danger for the patient.

Ligation must be supplemented by the use of a second ligature or there will be leakage, as the tissues soften under the ligature. As soon as the pressure from the accumulation equals the blood-pressure, secretion ceases and the kidney ultimately atrophies. The success of this procedure, as well as that of extirpation of the kidney, is largely dependent upon the condition of the other kidney, as it must do all the work. Intestinal anastomosis is unsatisfactory. The introduction of urine into the intestinal canal from its irritation increases peristalsis and thus occasions annoyance. The danger of infection of the kidneys is not insignificant.

Anastomosis between the two ends of the ureter presupposes that they can be readily brought together, and that the peripheral end is patulous and can be made to receive the upper end without obstruction. The end of the peripheral portion should be closed and the communication be made through a slit in its side.

Undoubtedly, where it can be accomplished the direct implantation of the end of the ureter into the bladder is the most desirable procedure. The point of entrance should be made at the upper part by a small incision, the muscular walls should be united by fine catgut and a second row of sutures to the external surfaces. No traction should be made upon the ureter by the bladder. If it has been neces-

sary to somewhat displace the bladder, it should be anchored to the surrounding tissue to prevent dragging upon the ureter. Drainage should be used to afford vent for any possible leakage. Intestinal and bladder lesions should be carefully sutured before the wound is closed.

**Malignant Neoplasms.**—Under this title may be classed the various forms of cancer and sarcoma. They may affect any part of the genital tract, but primarily, most generally, the uterus or vulva, rarely the vagina. While malignant disease is most frequently found to occur near the climacteric, it may affect the woman at any age, whether married or single. When the disease occurs early in life, either from inability of the system to resist its ravages or from special susceptibility to its influence, the progress is rapid. Medicine, either local or general, has afforded us but little assistance. So-called specifics have been advocated, but their efficacy is only apparent to those who have introduced them. Recently, various remedies have been given hypodermically with the purpose of arresting the progress of the disease. These remedies are injected into the diseased structures. As the majority of the cases have passed beyond the stage when hope for cure by any operative procedure can be entertained, it seems but proper that such investigations should be continued. Despres makes deep injections of refined petroleum, which, while painful, cause speedy separation of sloughs, desiccation of ulcerated surfaces, and disappearance of odor.

Schultze of Buda-Pesth and Vuillet of Geneva advocate the use of absolute alcohol; the latter injects it by a number of syringes deeply into the indurated tissue, permitting the instrument to remain some time to prevent the fluid running back through the needle-track. It causes hardening of the tissue and gradual separation of the diseased tissues.

Lewis and Boldt have given pyoktanin hypodermically with beneficial results. It should not be given in doses larger than gr. iiss at any one sitting.

Bernhardt advocates the use of a 6 per cent. solution of salicylic acid in alcohol at 60°. Seven or eight injections of a few drops should be given at each sitting, the whole quantity not to exceed ℥xxxj.

Where the disease is too extensive for radical cure we have to consider palliative measures. The progress of the disease may be arrested or delayed by the use of the sharp curette, followed by the application of a caustic. The most effective caustic is undoubtedly the zinc chloride. Great care must be exercised in the use of this agent to confine its destructive qualities to the diseased tissue. Without special precautions the vagina and vulva are prone to become burned, sometimes



to the destruction of the vaginal walls. The actual cautery is another valuable agent. Its application is somewhat difficult, as the thermo-cautery becomes so cooled by the blood that it requires frequent reheating.

These measures arrest hæmorrhage and cause sloughing of the broken-down tissue and cicatrization of the diseased surfaces. The arrest of the severe drain soon produces a greatly improved condition and appearance, but unfortunately it is only temporary. In bad cases the disagreeable odor, the pain, and the hæmorrhage are the symptoms which will demand especial consideration. The vagina should be irrigated with large quantities of hot water, salt solution, peroxide of hydrogen and water, a solution of listerine, or the chlorinated waters, of which one of the best is a preparation known as electrozone.

Lucas advises the following powder as a dressing: Benzoin, iodoform, magnesii carbonat.,  $\bar{a}\bar{a}$ .  $\bar{z}\bar{i}\bar{j}$ —which will arrest and diminish the fœtid discharge and prevent excoriation of the vulva and vagina. Hæmorrhage is controlled by injections of hot saturated solution of alum, the use of perchloride of iron, followed, if necessary, by gauze packing.

Pain frequently is so severe as to require the use of large quantities of anodynes. While in hopeless cases we should have no hesitation as to the formation of the opium-habit, yet it is better for the patient that its use should be delayed so long as relief can be maintained by other drugs. The agents which may be serviceable are belladonna, hyoscyamus, chloral, antipyrin, and acetanilide. When opium is given, it should be husbanded so that its effect may not be exhausted before the disease has run its course. It may be given by the mouth, in the form of a suppository by the rectum, or hypodermically. The use of the hypodermic syringe should not be placed in the hands of the patient or a member of the family, as the quantity of the drug will be augmented too rapidly.

OPERATION.—None of the measures we have given should be for one moment considered where the case is operable. When the disease is confined to the uterus, whether it originated in the cervix or body of the organ operation, should be advised. We may choose between high amputation and extirpation. It seems just as desirable to get well beyond the confines of the disease when it originates in the uterus as in involvement of the mammary gland, consequently hysterectomy should be preferred. This operation may be done either through a vaginal or abdominal incision. If the disease is confined to the canal of the cervix or to the body of the uterus, the vaginal operation is the preferable procedure, as by it the uterus can be removed in less time and with less dissection. The operation may be



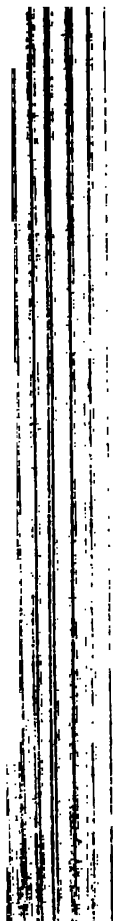
done with the use of ligatures to prevent hæmorrhage, or we may resort to clamps. The latter method of hæmostasis is the more expeditious, and no ligatures remain to become infected and keep up subsequent discharge, but the tissue in the grasp of the clamps is devitalized, sloughs, and becomes a source of danger from infection. The removal of the clamps even at the end of the second day is sometimes followed by serious hæmorrhage. The dragging of the clamps adds very much to the patient's discomfort. In extensive involvement of the uterus, extending upon the vagina and with a suspicion of extension into the broad ligaments, the abdominal incision affords the best opportunity for thorough removal. It permits an inspection of the condition of the pelvic contents and removal of a large amount of tissue. Clark and Kelly have advocated the previous introduction of catheters into the ureters, but the danger of breaking a catheter, the difficulty in the subsequent removal of the fragments, and the fact that such landmark is unnecessary render it inadvisable.

The principal dangers in the operation are hæmorrhage and injury to the ureters. When it is apparent that they are liable to injury or ligation it is better that the peritoneum should be opened, and the ureter raised and held to one side while the dissection and ligation are accomplished.

Generally hæmorrhage can be prevented by ligation of ovarian and uterine arteries, but in extensive involvement of the pelvic floor, where the disease extends upon the vagina, the ligation of the anterior trunk of the internal iliac arteries (Kelly, Polk) may be practised. Ordinarily this arrests the circulation in the superior, middle, and inferior vesical, the middle hæmorrhoidal, the uterine, the vaginal, the internal pudic, the obturator, and the sciatic, but the distribution of the vessels between the anterior and posterior trunks is uncertain and the anterior trunk is frequently very short (Pryor), so that the writer in a recent case ligated both internal iliac arteries. The ovarian arteries had previously been ligated. The tissues were then cut away without the necessity of any further ligation. The ligation of the entire vessel only arrests the circulation, in addition, through the lateral sacral, the ileo-lumbar, and the gluteal arteries. The tissues supplied by these vessels are capable of being cared for by the collateral circulation. In addition to the better control of hæmorrhage, the more expeditious operation, the greater security for the ureters in that they are under observation, this procedure affords a hope that any portion of malignant disease unremoved may disintegrate and be thrown off, owing to its circulation being temporarily arrested. The diseased tissue being less highly organized is more easily starved.

The surgical treatment of pelvic cancer should not be dismissed

without reference to the readiness with which malignant disease of the uterus can be reached by the operation of sacral resection. The extent of dissection and injury to bone-structures will forbid its practice unless the affection of the uterus is complicated with involvement of the rectum. This section permits the diseased organs to be attacked directly from behind, where the ureters are readily observed and avoided, the vessels easily ligated, and the organ most readily accessible.





## THE THERAPEUTICS OF PREGNANCY, PARTURITION, AND THE PUERPERAL STATE.

By EDWARD P. DAVIS, A. M., M. D.

WE shall the better understand rational methods of treatment during pregnancy, parturition, and the puerperal state by a brief review of the physiology and pathology of these conditions.

Normal pregnancy is characterized by a decided increase in the activity of the nutritive processes and by a corresponding burden upon the excretory organs. Accompanying these conditions, the nervous system responds to increased demands upon it and great functional activity of the vital organs of the body is the result. In a normal patient the condition is one of physiological development and plethora. The blood is richer than normal in hæmoglobin and in well-developed corpuscles. The muscular and elastic tissues of the circulatory organs increase in size to answer to the demands upon the heart and bloodvessels. The skeleton of the patient undergoes changes necessary in sustaining the weight of the growing child and in giving it egress from the body of the mother. The healthy pregnant patient by reason of increased physiological functions and rich blood is well protected against infection and against many disorders to which the non-pregnant may readily be subjected. Accompanying this bodily condition there is often a corresponding mental stimulation which contributes to the patient's general well-being.

When we consider the pathology of pregnancy we are not surprised to find that patients whose powers of blood-making and excretion are naturally defective should do badly when the increased strain of pregnancy is brought to bear upon them. In early pregnancy reflex irritation from the growing uterus and the general nervous and mental disturbance which the condition brings about naturally interfere greatly with the patient's nutrition, and pernicious nausea and other functional neuroses may readily develop. Anæmia and consequent neuralgia are often seen. The salivary glands may perform their functions abnormally, and the teeth may undergo important changes. In the first three months of pregnancy abortion and pernicious nausea are the great pathological conditions which may be present.

The second three months of pregnancy are characterized by a much better equilibrium and greater freedom from pathological conditions. The uterus has risen out of the pelvis, the nutrition of the patient improves, while the tax upon the excretory organs has not yet become excessive. The patient is able to take exercise, and the pathological element is least during this period.

During the last three months the question of excretion becomes paramount. Toxæmia in some degree is usually present, and may vary in its results from neuralgia, indigestion, malaise, and melancholia to severe eclampsia. The increased weight of the child and increased demands for its nutrition accentuate heart-lesions previously existing. The circulatory system may manifest disease in any of its ramifications. As pregnancy draws to its close, uterine intermittent contractions may weary the patient, the possibility of a premature detachment of the placenta must be taken into account, while premature labor may take place.

The physiology of parturition affords a most interesting example of the accommodation of the organism to the performance of a special function. The expulsion of the child requires the exercise of a large muscular force, while the phenomena of accommodation must be thoroughly evolved to secure a favorable issue for the infant. The exercise of unusual energy exposes the patient to considerable risk of exhaustion, while the emptying of the womb and the separation of the child from the interior of the uterus give an opportunity for severe or fatal hemorrhage. Traumatism in normal cases is avoided by the proportionate development of mother and child, and by the physiological elasticity of the tissues which develop throughout pregnancy. In healthy patients infection is avoided by the presence in the birth-canal of germicidal secretions and by the adaptation of the fœtus to the birth-canal, preventing the entrance of germ-laden air.

Pathological conditions arising during parturition occur very largely from lack of development in the mother and disproportion between mother and child. There is with this a corresponding lack of muscular power and general strength which causes delayed or impossible labor. If birth be accomplished through the natural channel, traumatism is inevitable and may become severe. Lack of vigor in the patient predisposes to hemorrhage and to the development of septic infection. The interference necessary to secure the delivery of the child exposes the patient to added risks of infection.

The normal puerperal state is characterized by the involution of the genital tract, the readjustment of the economy to its normal functions, the restoration of normal nutrition and excretion, and the development of lactation.

When, however, pathological conditions arise during the puerperal state they are most often the result of septic infection, which delays involution and may threaten the life of the patient, or through failure of the patient to make a proper recovery by reason of unrepaired injuries to the genital tract, or a lack of proper rest before assuming her usual occupation. Lactation may also develop pathological conditions in infection of the breasts, and in failure to form a proper secretion of milk. The patient's general strength must be thoroughly restored before she can successfully resume an active life, and, in addition, nourish her infant. The tendency of civilized life is to make perfect recovery from childbirth and successful lactation comparatively rare.

#### THE NAUSEA AND VOMITING OF PREGNANCY.

In from 20 to 25 per cent. of cases of pregnancy the patient is annoyed by nausea and vomiting. In milder cases this occurs at morning only, and disappears about the fourth month. In severe cases vomiting is variable, but nausea is constant, exhaustion supervenes, and the patient dies.

The cause of this condition remains unknown. In many cases an abnormal position of the uterus is present or some pathological lesion of the pelvic organs. In others a pathological condition of the stomach or intestine is present. In some patients a neurotic element is strongly in evidence, while in others tumor of the brain or chronic meningitis has been found. Those patients most likely to have this complication develop during pregnancy are primiparæ older than the average, highly neurotic individuals, and those who have always had a sensation of nausea readily excited by some slight cause.

In attempting to treat this condition one must distinguish between vomiting and nausea. Vomiting, unless exceedingly frequent, is of minor importance as a symptom. Hysterical patients vomit at will, and occasional vomiting without straining does not greatly depress the patient. The sensation of constant nausea, however, is of grave importance. It is invariably accompanied by severe nervous prostration and by rapid loss of strength. In serious cases it is temporarily relieved by narcosis or by sleep, and is never permanently cured until the uterus is emptied.

The rational suggestion in these cases would be to use in treatment some of the many drugs which stimulate the pneumogastric nerve through the mucous membrane of the stomach. Diffusible stimulants, tonic bitters, wines, coffee, and tea are used for this purpose. The patient may take black coffee before rising in the morning, or dry champagne or tea, or she may use a combination of carminative drugs before each meal. A combination of gentian, cardamom,



and elixir curacao, with one or two drops of Fowler's solution to the teaspoonful, is sometimes of service in these cases. This should be taken before eating.

The effort to control this condition by sedatives and narcotics has been made. The hypodermatic injection of morphia or codeia has been given a thorough trial. Rectal injections of bromides of ammonium, sodium, and potassium with chloral hydrate are employed by many. For a short time phenacetin, antipyrin, or acetanilid has been used. Cannabis Indica has been given a trial, and hyoscine has also been used.

Electricity seemed to promise considerable benefit by faradization along the spine, with one pole of the current over the epigastrium.<sup>1</sup> Hypnotic suggestion has also been employed.

A carefully selected diet is of the first importance. Unless the patient be under the care of a nurse, it is impossible to tell how much food is retained. Until the nurse can be procured, the patient should be instructed to furnish her physician at desired intervals with a written memorandum of food taken and retained. In attempting to suggest diet, one is often confronted by an imaginary longing for some extraordinary article of food. Thus, a patient will select some peculiarly sour and indigestible sort of pickle and desire to eat largely of it. A craving for acids is not infrequent in these cases. Other patients wish to eat large quantities of ice. Others desire smoked or salted fish, and others highly spiced dishes of various sorts.

It is a mistake to give too much attention to these cravings. They are a neurotic phenomenon, and if one be indulged another will often take its place. It is better to limit the diet to strictly nutritious and digestible food, using a simple carminative tonic to bring about a better condition of the stomach. Broths, soups, meat jellies, junket, pancreatized or peptonized milk, beef-juice, peptonized oyster-livers, clam-broth, kumiss, vegetable purées, eggs beaten up with lemon-juice or with sherry, scraped beef sandwich, grilled marrow, broiled sweetbreads, cream-toast, and all fresh fruits in season will be found advantageous. The patient's taste should be especially encouraged in the matter of eating fruit. Such cases will sometimes consume very large quantities of oranges to great advantage.

The use of alcoholic beverages and of tea and coffee should be very carefully guarded. If the patient has used wines habitually, a small quantity of dry white wine may be advantageous. Although

<sup>1</sup> Gantier (*Archiv de Tocologie*, Jan., 1895) has treated twenty cases of vomiting of pregnancy by the galvanic current. The positive pole is applied above the right clavicle, the negative at the umbilicus. The current is descending, of slight intensity and long duration.

temporary relief may follow the use of undiluted brandy or whiskey, this will be but temporary, and will do no good. Effervescing waters or mild saline waters may be freely taken. Their combination with wine is often of advantage. If coffee be used, it should preferably be black and freshly made; and if tea be employed, English breakfast tea freshly made with lemon and a small quantity of sugar will be best borne. Tea and coffee taken continually aggravate the condition present instead of relieving it.

Considerable importance attaches to the manner in which food be given and the surrounding circumstances as well. Food must be prepared in the best possible manner, and served in the most appetizing way and amid the most pleasant surroundings. The patient will occasionally experience a marked revival of appetite if she goes to the house of a friend, where an entire change of surroundings proves most beneficial. The patient should not be consulted on each occasion regarding her food, and if possible she should not order it, but the preparation of her diet should be entrusted to a nurse or a competent and faithful servant.

When it is found impossible with ordinary precautions to nourish the patient by the stomach lavage should be tried. This is often followed by temporary relief, but is rarely of permanent benefit. When the stomach will retain nothing rectal feeding is our best resource. The following formulæ have been found advantageous:<sup>1</sup>

- |                            |                     |
|----------------------------|---------------------|
| 1. Beef-tea,               | oz. 3;              |
| Yolk of 1 raw egg,         |                     |
| Brandy,                    | oz. $\frac{1}{2}$ ; |
| Liquor pancreaticus,       | dr. 2.              |
| 2. One whole raw egg,      |                     |
| Table salt,                | gr. 15;             |
| Peptonized milk,           | oz. 3;              |
| Brandy,                    | oz. $\frac{1}{2}$ . |
| 3. Beef-tea,               | oz. 2;              |
| Brandy,                    | oz. $\frac{1}{2}$ ; |
| Cream,                     | oz. $\frac{1}{2}$ . |
| 4. Beef-tea,               | oz. 2.              |
| One whole raw egg.         |                     |
| 5. Beef-juice,             | oz. 1.              |
| 6. Beef-essence,           | oz. 6.              |
| 7. Whites of two raw eggs, |                     |
| Peptonized milk,           | oz. 2.              |
| Two eggs.                  |                     |

<sup>1</sup> These formulæ were kindly furnished for my *Treatise on Obstetrics*, by Miss M. E. Smith, Chief Nurse of the Philadelphia Hospital.

While rectal feeding is being carried on the bowels should be thoroughly washed out each morning, and scrupulous asepsis must be practised with the rectal tube and strict cleanliness with the patient. The patient may be often turned on the left side to advantage and her hips elevated before the insertion of the injection.

As adjuvants to the care of the patient's nutrition, precautions must be taken that her strength be preserved in every possible way. Not only must rest in bed during the whole or part of the day be insisted upon, but influences disturbing the nervous system, fatigue, shock, extremes of cold and heat, anxiety, and mental depression must all be guarded against so far as possible. It is often exceedingly important to take a patient absolutely away from her usual surroundings. She should be entrusted to the care of a nurse, or of a faithful, kindly, and intelligent friend. When the patient is too weak to be moved she should be freed at home from annoyance or interruption from every quarter.

We may obtain a slight result in these cases by inunctions with nutritious substances; thus, olive oil (two parts) and alcohol (one part) may be employed once daily after a warm sponge-bath. The care of the skin must be assiduous, and very light massage with gentle bathing often proves advantageous.

No case of this sort can be intelligently and thoroughly treated without a vaginal examination to determine the presence or absence of pelvic conditions that may seriously influence the progress of the patient's malady. If the womb be found in abnormal position, it must be replaced and a proper support applied. Tampons of carded wool are especially advantageous, and may be made of a size and shape suitable for each individual case. The patient should be put in the knee-chest posture, the posterior wall of the vagina drawn strongly backward by a Sims speculum, and the entire pelvic viscera allowed to gravitate upward and forward. A suitable tampon may then be applied, while the patient still retains this posture. In a few cases improvement has followed raising the hips of the patient to a very marked degree. The explanation of this result is found in the fact that in these cases the uterus is just about to ascend out of the pelvis into the abdomen, and that the raising of the hips contributed to this result.

Repeated trial has been given of cervical dilatation for this disorder. Either the finger or an instrumental dilator may be employed. In cases in which the mucous membrane of the cervix is swollen and reddened this may be accompanied by the application of tincture of iodine to the cervix. Some patients are relieved by this; in many it is without avail.

In cases in which exhaustion is extreme hypodermoclysis or intra-



venous transfusion is indicated. This will serve as a temporary expedient to maintain the action of the heart. It is especially useful after operation when it becomes necessary to empty the uterus.

In a considerable number of cases the most carefully devised and thoroughly performed treatment is without avail. The patient may cease to vomit, but the sensation of nausea continues while exhaustion rapidly increases. Signs of a dangerous condition are to be found in coffee-ground discharges from the stomach or bowels; in obstinate burning or boring pain beneath the sternum; in sordes upon the mouth and tongue; in a rapid, feeble pulse; and in the persistence of the sensation of nausea. An examination of the urine in these patients will show that when a critical condition has arisen there is a considerable diminution in the solids secreted, while albuminuria may develop. Under these conditions no greater mistake can be made than to delay the emptying of the uterus.

In terminating pregnancy in these cases methods of gradual dilatation of the uterus should not be chosen during early pregnancy. The degree of exhaustion which accompanies continued suffering is so great that the womb should be emptied under an anæsthetic and as rapidly as is consistent with safety. The patient should be anæsthetized with ether or with chloroform and oxygen, and the womb dilated, preferably by solid dilators. The ovum should be curetted away and the womb thoroughly emptied. Should there be a tendency to hemorrhage, a packing of iodoform gauze is indicated. After the curetting the womb should be carried well up in the pelvic cavity by a vaginal tampon of bichloride gauze. This should be replaced at intervals sufficiently short to keep the womb supported and to lessen distinctly the tension upon the pelvic tissues. In successful cases the sensation of nausea ceases as soon as the patient wakes from the anæsthetic. It is noteworthy that in these cases she does not commonly vomit after rousing from the anæsthesia.

The after-treatment of these patients requires a thorough correction of the profound anæmia which is present. *Nux vomica*, Fowler's solution, and gentian may be used to advantage, while some easily assimilated preparation of iron may be taken after meals. Massage is of especial value, while an abundance of fresh air and a suitable climate are most important. Under these precautions patients usually make a complete recovery and, if the curetting has been done thoroughly, a succeeding pregnancy may result successfully.<sup>1</sup>

<sup>1</sup> An excellent *résumé* of the treatment of the vomiting of pregnancy will be found in Bacon's article, *American Journal of the Medical Sciences*, June, 1898, page 683. Interesting cases are also reported in a recent paper by Kuehne, *Monatsschrift für Geburtshilfe und Gynäkologie*, Band x., Heft 4, 1899.

### ABORTION.

The treatment of abortion naturally resolves itself into prophylactic and curative.

In preventing abortion, constitutional peculiarities in the patient must be taken into consideration. In some cases the uterus has been retroverted for a number of years, and as it occasioned the patient no distress the condition did not become evident until pregnancy occurred, when the enlarged womb became incarcerated in the hollow of the sacrum and abortion resulted. In other cases a sharply ante-flexed uterus unfolded with such difficulty when pregnancy occurred as to cause abortion. It is difficult to prevent these accidents in such patients because, in the lack of positive suffering before marriage, they rarely consult a physician. When, however, an abortion occurs and such a condition be present, the opportunity to remove this causal factor should not be neglected.

Many women during the first pregnancy have no idea regarding what sort of exertion is dangerous for the continuance of the pregnancy. They must be cautioned that climbing steep stairs, lifting, reaching high above the head, or the use of a sewing-machine or any other apparatus working with a treadle, is distinctly dangerous. A pregnant patient will often endure considerable violence without aborting when frequent jarring or repeated strains not noticed at the time will result in accidents.

All disturbing elements so far as possible must be removed from the patient's life. Emotional disturbances, profoundly depressing conditions, great anxieties, and continued worry must, if possible, be avoided. There can be no doubt that vicious dress and waist-constriction may produce abortion. The patient should adapt her clothing to her condition so soon as it becomes assured.

In cases of habitual abortion the patient's history must be carefully examined to detect the cause of the repeated accidents. If syphilis be present, it must receive appropriate treatment, together with medication addressed to the anæmic condition which accompanies it. If a chronic displacement of the womb be the causative factor, this must be corrected; and if a certain period of gestation has proved especially hazardous, the patient should pass this period in bed.

In cases in which the general state of the patient is bad, and in which she is distinctly failing in strength, she should be put to bed under suitable care for the first few months of pregnancy. Under these circumstances abortion may be prevented.

When symptoms of abortion appear in pain and hemorrhage, the first indication is to put the patient absolutely at rest. She should not leave her bed to empty the bowels or bladder. All disturbing



influences must be prevented, the patient should be encouraged to hope that a favorable issue may result, and she should have the services of a competent attendant or nurse. An antiseptic napkin should be worn, and all discharges should be examined by the physician in attendance. The patient should be especially cautioned not to throw away blood-clots, but to save them for the physician's examination. A semi-liquid diet and the regulation of the bowels by enemas or simple remedies should be enforced. If the patient be highly nervous and complain of considerable pain, opium may be used sufficiently to give rest at night. It is not our experience that opium-narcosis prevents abortion, but rather that it favors the separation of the ovum from the wall of the uterus and makes its ultimate discharge inevitable. Opium may be given to these patients in rectal suppository containing from  $\frac{1}{4}$  to  $\frac{1}{2}$  grain of the aqueous extract, with  $\frac{1}{4}$  grain extract of belladonna, 2 grains of iodoform, and cacao-butter sufficient to make the suppository. One should be inserted in the bowel in the early evening. If the patient's condition of restlessness be acute, and it is desirable to check it as soon as possible, morphia must be given by hypodermatic injection. It should be remembered that many of these cases are in a weak and prostrate condition, and that women in such a state are often very susceptible to the action of opium. The dose should rarely exceed  $\frac{1}{8}$  grain of morphia combined with atropine, and it should preferably be given at the usual bedtime. In some patients, codeia is quite sufficient to control the patient's restlessness. In other patients, rectal injections of bromides with choral hydrate prove efficient. It must be remembered that no sedative prevents the separation of the ovum from the wall of the womb, but rather encourages it, if given in large doses, by favoring relaxation of the uterus. In cases in which the womb is found enlarged and very flabby, success has sometimes followed the use of tonic doses of strychnia, the uterine muscle contracting under this drug and retaining the ovum within the cavity of the uterus. *Viburnum prunifolium* has enjoyed considerable reputation as a uterine sedative. The writer has never seen it do harm, and has rarely been positive that it did good.

Should hemorrhage continue, abortion sooner or later is inevitable, and the loss of blood should be terminated as soon as possible. While it is said that very rarely a patient dies from hemorrhage following abortion, it is true that the patient may become so weakened from this cause as readily to become septic or occasionally to perish from shock under the use of an anæsthetic. As the abortion proceeds the physician's efforts must be directed to securing the complete expulsion of the ovum in an aseptic manner. Antiseptic napkins must be worn, and the external parts should be thoroughly cleansed



with soap and water and with bichloride solution (1:2000). If it is feared that the patient may become contaminated, the vagina should be thoroughly douched with bichloride solution (1:4000), and every precaution taken to render the hands of the physician and nurse antiseptic before examining or manipulating the patient. The patient should be encouraged as the pains grow worse to assist them somewhat by bearing down; and she may assume the semi-upright posture to secure if possible the complete expulsion of the ovum. If this occurs, and the physician sees the entire ovum, examines it carefully, and is convinced that nothing remains within the womb except the decidual membrane, further interference is unnecessary. Unless, however, the physician can personally assure himself that such is the case, it is his duty to introduce the finger or a curette within the uterus and to explore its cavity thoroughly. If the patient is nervous and frightened, this should be done under an anæsthetic. It is our custom when employing an anæsthetic to use ether, to dilate the womb thoroughly, to examine it with the finger, and to curette and wash it out. If a tendency to hemorrhage exists, the uterus is tamponed with iodoform gauze. The womb must then be placed in proper position in the pelvis and supported in that position by a vaginal tampon of bichloride gauze. In this way proper drainage of the uterine cavity is secured and the risks of infection greatly lessened. Under strict antiseptic precautions the patient should make after abortion an uninterrupted recovery, so far as the local conditions are concerned. Attention, however, must be paid to the correction of any displacement of the womb which may have caused the abortion, or to anæmia, syphilis, or any other constitutional disorder which may have been instrumental in producing the accident. If the patient be thoroughly treated at this time, the next pregnancy should result successfully and the general health of the patient be decidedly improved. If, however, she be not treated in a thorough and competent manner, an abortion is the beginning of ill-health lasting through the life of the individual.

In cases of abortion complicated by septic infection there is much which can be done through general treatment to prevent serious lesions of the tubes and ovaries. The uterus should first be thoroughly emptied and cleaned; the patient's bowels should be thoroughly moved by Rochelle salt or sulphate of magnesium. If fever be present, ice-bags should be placed on the lower portion of the abdomen, and these means will often render unnecessary the use of opium. Strychnia should be given in tonic doses, alcohol should be freely administered, liquid and predigested food should be given in abundance, and special symptoms should be met by the use of remedies addressed to them. If the patient cannot sleep at night, codeia in

$\frac{1}{2}$ -grain doses, together with alcohol, will usually be efficient. While the patient cannot be purged by salines daily, still the bowels should be kept freely moved. When the saline is not given by the mouth it may be administered by the bowel in the following combination :

Sulphate of magnesium,	oz. 1 ;
Glycerin,	oz. 1 ;
Spirits of turpentine,	dr. 2 ;
Water,	oz. 8.

This should be injected as high in the bowel as possible through a soft rectal tube. It will usually result in a free discharge of fecal matter. These measures in our hands have been successful, in most cases of septic abortion, in preventing peritonitis and in causing the ultimate disappearance of lesions in the tubes and ovaries. In our experience, it is best not to employ frequent copious hot vaginal douches after septic abortion, but simply to irrigate the vagina with sufficient frequency to keep it clean.

#### THE TOXÆMIA OF PREGNANCY.

Few patients while in the pregnant condition escape from diminished excretion caused by the increased demand upon the maternal organism. So slight may be the degree of this condition that it may remain entirely undetected and its effects be ascribed to another cause. Thus many of the mental and nervous peculiarities of the pregnant condition are found to disappear when the patient's excretory organs are roused to increased activity. While we may not be able to identify the precise toxin causing these phenomena, there can be no doubt that the products of the patient's own tissues furnish the poisons which depress her.

This condition may be diagnosticated through the nervous phenomena of toxæmia, by observing the action of the excretory organs, and by an examination of the urine.

The diagnosis made, successful treatment demands a thorough survey of the patient's hygiene with precise directions regarding food, the use of water, baths, dress, exercise, and general hygiene. In selecting diet for these cases food should as nearly as possible be embraced in the category of milk, fruit, and bread. The heavier sorts of food must be entirely omitted ; meat may often be given up to great advantage, while an abundance of fruit, of vegetables, milk, and well-baked bread should form the remainder of the diet. To stimulate the patient's excretions, if the tongue be furred and coated,  $\frac{1}{4}$  grain of calomel with several grains of sodium bicarbonate may be administered every other night for a week. On the morning fol-

lowing, Rochelle salt or citrate of magnesium must be taken. For continued use, a mild saline water is best. Celestin Vichy when it can be obtained, or moderate doses of Rochelle salt in an abundance of water, answer this purpose best. To remedy the constipation which is often present, after the liver has acted, the bowels must be moved daily by cascara, by suppository, or by injections. Water should be taken with regularity and in exact quantities. From one to two quarts may be consumed to advantage in twenty-four hours, it being taken upon rising in the morning, between meals, and on retiring at night.

To relieve the restlessness from which many of these patients suffer at night, a warm bath before retiring is especially valuable. A cool sponge in the morning should also be employed. Abundant fresh air, the use of woollen clothing next the skin, and entire freedom from constriction by clothing are also necessary for these patients. Outdoor exercise which stops short of absolute fatigue and exhaustion is of great benefit. Patients may be encouraged to walk or drive, spending as many hours as possible in the open air. In cases in which the patient has become exhausted through excessive work or through excessive mental anxiety she should be put at absolute rest in bed. This is especially important in cases in which melancholia, great apprehension, obstinate neuralgias, and other phenomena of exhaustion are present.

If the physician fails in his treatment of toxæmia, eclampsia will develop. In the presence of this severe complication of pregnancy tentative treatment is worse than useless. Two indications are plainly present: the first is to control the convulsions; the second, to cause the patient to eliminate as rapidly as possible the poison which causes them.

For controlling the convulsions, chloroform is most easily administered, most efficient, and in the majority of cases most generally useful. It should be given freely mixed with air, and its administration should begin at the first sign of convulsions, and not when the fit has fully developed.

To cause the patient to eliminate as rapidly as possible, the liver, kidneys, and intestine should be made to act and the skin should be stimulated. If possible, the stomach should be washed out until the water returns clear, and from  $2\frac{1}{2}$  to 5 grains of calomel with from 10 to 20 grains of bicarbonate of sodium should be poured through the tube into the stomach and allowed to remain. A soft rectal tube should be carried as far as possible into the bowel, and from one to three gallons of warm normal salt solution be introduced. The patient should be catheterized, the amount of urine obtained noted, and the urine examined. The patient should be placed in a pack



composed of blankets wrung out of hot water, the legs being separately wrapped to permit the introduction of fluid into the rectum or a vaginal examination if necessary. An ice-bag or cloth wrung out of cold water is needed upon the forehead of the patient. If the patient's pulse be strong, the pulse-tension high, the pulse heavy and regular, 10 minims of the fluid extract of *veratrum viride* administered hypodermatically will lessen pulse-tension and favor relaxation of the neck of the womb. If a result is not quickly obtained, 10 minims more may be given in thirty minutes, and thirty minutes later a third dose of 10 minims, making 30 minims in all. Under the use of this drug the pulse should drop below 80 within one hour.

Hypodermoclysis, or intravenous transfusion with normal salt solution, is strongly indicated in these cases. If *veratrum viride* be employed and transfusion or hypodermoclysis, the indications for bleeding are more satisfactorily fulfilled than when blood is drawn from the veins. The quantity of fluid to be used beneath the skin or in the veins is limited only by its rapid absorption. Usually from one to two quarts may be employed to advantage.

As regards the rapid emptying of the uterus, the hint given by Nature should be followed rather than any independent procedure. If it be found that the womb be dilating, the child descending through the birth-canal until its extraction can be readily performed by version or the use of forceps, labor should be terminated as soon as possible. If, however, the cervix be tightly shut, the womb should not receive interference. If the patient be rescued from toxæmia, the pregnancy may go on, or the patient will come into spontaneous labor, which can receive suitable assistance.

We mention in this connection the treatment of eclampsia by large doses of morphia, by rectal injections of hydrate of chloral and bromides, by hypodermatic injections of pilocarpine, by Cæsarean section and forced and rapid delivery, because we believe them to be inferior to the method of treatment fully described. This opinion is based upon personal experience.

Patients who recover from eclampsia are exposed to certain dangers which require additional precaution on the part of the physician in attendance. Chronic lesions of the kidney not infrequently follow this serious complication. Restricted diet, the plentiful use of water, and the regulation of personal hygiene are necessary for some time. Pregnancy should be avoided for several years, and the general health of the patient made as good as possible. Anæmia is a frequent result of the toxæmia which leads to eclampsia. This requires thorough and prolonged treatment in connection with the proper repair of lesions occasioned by labor.

**DISEASES OF THE HEART COMPLICATING PREGNANCY.**

Pregnancy may occur in patients suffering from diseases of the heart. The increased strain thrown upon the organism during pregnancy naturally tends to aggravate pre-existing tendencies to degeneration of the heart-muscle and dilatation of the chambers of the heart. It is especially important that compensation be maintained during pregnancy. The use of drugs directly addressed to stimulation of the heart-muscle must be carried out with caution lest exhaustion of this muscle supervene. It is better to pay especial attention to the patient's nutrition, thus allowing the physiological hypertrophy of pregnancy to produce increased compensation. When the heart-muscle begins to fail compensation is lost and dilatation is threatened, and pregnancy must be terminated. This should be done in the quickest and least painful manner possible; and although the patient's dyspnœa may be severe anæsthetics may be safely used during delivery. A moderate blood-loss during labor should not be checked, as it tends rather to relieve the patient. Cardiac stimulants are required immediately after the emptying of the uterus, as rapid dilatation and fatal syncope may occur at this time.<sup>1</sup>

**ACCIDENTAL HEMORRHAGE DURING PREGNANCY.**

Premature separation of the placenta is accompanied by hemorrhage characterized as accidental. This may result from the premature separation of a normally situated placenta or from a placenta prævia. In the former case the symptoms of concealed hemorrhage—rapid, feeble pulse, pallor, shock, and air-hunger—gradually develop. The uterine muscle is partially contracted; the fœtus can with difficulty be outlined; the fœtal heart-sounds grow weaker and with altered frequency. There is sometimes the history of a blow, a fall, or bruise of the abdomen. In this dangerous complication delay is almost invariably fatal. The membranes should be ruptured, the uterus stimulated to contract, and the womb emptied as rapidly as is safe. Intravenous saline transfusion, the hypodermic use of strychnia and ergot, copious hot irrigation of the womb, and packing with iodoform gauze will be necessary at the moment of delivery. The child is almost inevitably lost if a considerable area of placenta becomes separated. The life of the mother can be rescued only by prompt and skilful action.

In central placenta prævia the patient is in imminent danger until

<sup>1</sup> An interesting clinical lecture upon this subject by Pinard is found in the *Medical Press*, 1898, No. 3065. In *L'Obstétrique*, 1896, No. 1, Demelin contributes an interesting paper upon the subject with statistics. Lea (*Medical Chronicle*, Oct., 1896) describes fully seven cases of heart disease complicating pregnancy and labor, and draws attention to the cardinal points in treatment.



the womb is emptied. Dilatation of the cervix by the use of the aseptic gauze tampon; prompt delivery by version, either internal or bipolar; free stimulation with transfusion; the hot intrauterine douche and tampon; and strict cleanliness are absolutely essential to success in these cases. The most important consideration which the practitioner can bear in mind in treating cases of central placenta prævia is the fact that from the moment when the diagnosis is made until the patient is safely delivered the case demands his individual attention.

In other cases of placenta prævia when the placenta is not central, but is partial, lateral, or marginal, the membranes should be ruptured and the fœtus brought down into the cervix, when the pressure of the child will control bleeding. These cases, if early diagnosed and promptly treated, rarely become of great severity.<sup>1</sup>

#### THE TREATMENT OF LABOR.

We rarely meet patients so physiologically perfect that parturition is not more successfully accomplished by judicious aid on the part of the physician. The treatment preparatory to labor consists in a thorough examination of the patient by pelvimetry, palpation, and auscultation, so that the physician is fully informed regarding the position and presentation of the fœtus and its location in the pelvis of the mother. If he knows that all of the mechanical factors for normal labor are present, he is justified in abstaining from active interference and in maintaining the patient's strength, knowing that a successful issue will follow. If, however, he is unaware of the existence of an abnormal pelvis, an unfavorable presentation, or some other complication, he may delay until too late active treatment which might save the life of the child and possibly that of the mother also.

When by preliminary examination it is seen that spontaneous birth can result, if the mother's expulsive effort be normal, the physician's treatment during the first stage of labor must be adapted to reduce the suffering of this period to a minimum, to further dilatation of the os, and to sustain the patient's strength for the muscular effort required in the expulsive stage of labor. There is no sedative drug of proved value that has not been employed to mitigate the suffering of the first stage of labor. Few are of positive value, however, and many are disadvantageous from the fact that they tend to lessen uterine contraction and thus delay the progress of parturition. We have seen good results follow the administration of hydrate of chloral given in doses of 10 grains each until three have been taken. Should the stomach be irritable, 20 grains of hydrate of chloral may be given

<sup>1</sup> In the *American Journal of Obstetrics*, February, 1893, page 191, Rosenberg contributes an interesting paper on accidental hemorrhage and reports cases.



by rectal injection in 1 ounce of warm milk and 3 ounces of water, and repeated in one hour if necessary. Phenacetine is occasionally useful in patients susceptible to its influence. Codeia by hypodermic injections in doses of  $\frac{1}{4}$  grain is often useful. When the patient is restless, suffering, and anxious, and evidently losing strength through fatigue, the hypodermic use of  $\frac{1}{4}$  grain of morphia with  $\frac{1}{100}$  grain of atropine will be followed by relief. A few hours of refreshing sleep will prove of the greatest value in such a case.

While we may seek to mitigate the nagging pains of the first stage of labor by drugs, there is much that can be done in the way of rational treatment without drugs. The bowels should be thoroughly washed out by a copious enema; and we have found 2 ounces of castor oil or sweet oil, the yolk of 1 raw egg beaten up with one tablespoonful of spirits of turpentine, and 2 quarts of hot castile soap-suds a satisfactory enema in these cases. This should be injected while the patient lies upon her left side. The fluid should be carried as high into the bowel as possible, and the patient encouraged to retain it until faecal matter has become thoroughly softened. The relaxing influence of a hot injection in the rectum is considerable in furthering the dilatation of the cervix uteri. A warm tub-bath is also of decided value in these cases, and serves not only to relax the muscular tissues of the patient, but also to divert her attention from her own suffering. Some have employed hot vaginal douches to promote softening of the cervix in the first stage of labor. The objection to this practice lies in the fact that douches remove the normal mucous secretion, which is germicidal in its property, and that danger from such douches must sometimes arise. It has not been our practice to employ this method of treatment. While the child is descending through the brim of the pelvis, and especially as it reaches the pelvic floor, the posture of the patient may facilitate the progress of labor. The primiparous patient should be up and about as long as her comfort will permit. If she wishes to assume the sitting posture, she should incline the body forward, thus directing the child downward and backward through the pelvic brim. If she lies down, she should lie upon that side toward which the presenting part is directed, as rotation will thus be facilitated. With these methods, which are simple and readily applicable, much can be done to avoid the use of drugs and to facilitate the progress of the first stage of labor. It must not be forgotten that the patient should receive liquid food at sufficient intervals to maintain her strength, and that should she be threatened by exhaustion moderate stimulation should be combined with liquid feeding.

In the treatment of the second stage of labor much attention has been given to the use of what are known as ecboic drugs. Ergot, quinine, nux vomica, and various other substances have been admin-

istered to increase the vigor of uterine contractions and thus expedite labor. It is possible by ergot to produce strong tetanic contractions of the uterine muscle; but experience has shown that injury to mother and child often results; that detention of the placenta may occur; and that the general result of such treatment is not advantageous. There is no drug of value as a distinct stimulant to the uterus only. When the nervous system of the mother is deficient in vigor or when she is threatened with exhaustion, those stimulants which enhance her general force will be found useful in labor. Thus, tonic doses of sulphate of quinine, of alcohol, of tea, or of coffee are useful with many patients. Quinine may be given to advantage in capsules combined with pepsin. This combination with liquid food is often retained when without pepsin the quinine would be rejected. In some cases small doses of strychnia are of value during the second stage of labor in producing a better tone to the general nervous system.

The use of anæsthetics during labor is a reasonable effort to reduce the suffering of the patient at this time to a minimum. Were it not for the fact that surgical anæsthesia often lessens the pains of labor, making uterine contractions less vigorous, and thus delaying parturition, the use of anæsthetics would be a comparatively simple matter. Under the circumstances the physician should avoid the free use of anæsthetics until labor is so far advanced that he can if necessary terminate the delivery by forceps or version. A mild degree of anæsthesia, however, which lessens the patient's suffering at the moment of the expulsion of the child may be readily produced, and is of great value to the patient and great assistance to the physician by enabling him to prevent laceration and to control the progress of labor. For the accomplishment of this degree of anæsthesia chloroform is especially adapted. It is readily taken, acts quickly, its effect passing off promptly, while it causes less nausea in many cases than does ether. On the other hand, it is more relaxing to the uterus if given freely, and without due caution it may favor relaxation of the womb and even the occurrence of post-partum hemorrhage. For this reason many prefer the exclusive use of ether.

In spontaneous labors, as the head descends, we are accustomed to give the patient a very small quantity of chloroform at the time when the head is distending the pelvic floor, and when a few strong uterine contractions will expel it. This is best done by pouring upon a napkin or handkerchief enough chloroform to wet an area the size of a quarter, allowing the patient to hold this over the nostrils while breathing deeply. At the moment when the head must be restrained to prevent its rapid expulsion, the patient is given more chloroform and is allowed to become slightly narcotized. In this

condition she feels little if any pain, although patients have stated that they heard what was said at the time. A few moments of this stage of anæsthesia enables the physician to deliver the head of the child entirely under his control, relaxes the pelvic floor, diminishes the risk of laceration, and is a great comfort to the patient.

It is occasionally necessary to use an anæsthetic to enable the physician to remove the placenta. In some patients, pain, fright, and resistance are so great that it is impossible for the physician to remove the placenta without anæsthesia. In these cases a small quantity of chloroform is most efficient and convenient.

In obstetric operations in which the physician desires to utilize the contractions of the uterus ether is the preferable anæsthetic. For the use of forceps, for craniotomy, for repair of the cervix and pelvic floor and perineum, for curetting, Cæsarean section, and symphysiotomy, ether is to be preferred. When, however, the physician desires to relax the uterine muscle, rendering it absolutely quiescent during his manipulation, chloroform is the better anæsthetic. For version, for manual removal of the placenta, and for the control of eclampsia, chloroform is preferred. If carefully given, the danger of hemorrhage and shock is not increased by chloroform.

Methods of local anæsthesia<sup>1</sup> have been tried during labor, but without success. The use of cocaine upon the cervix or injected into the pelvic floor has not proved of practical value. The physician may often take advantage of the benumbing influence which pressure exerts upon the parts when it is necessary to close the pelvic floor. It will be found that stitches may be inserted with comparatively little suffering to patients if the needles used be sharp and the stitches be inserted as soon as possible after the delivery of the child. Some obstetricians prefer to insert the stitches before the expulsion of the placenta, in the short interval which follows the birth of the child before the delivery of the after-birth.

The treatment of the third stage of labor requires the proper understanding of the physiology of placental separation and expulsion, with personal attention on the part of the physician. If it be remembered that the placenta must first be separated from the wall

<sup>1</sup> An interesting paper upon the influence of morphine and ether in labor may be found in the *Archiv für Gynäkologie*, 1898, Band 40, Heft 1, by Hensen. He shows that morphine in ordinary doses does not affect the contraction of the uterus and abdominal muscles. Ether and chloroform cause the contraction of these muscles to cease temporarily.

In the *Boston Medical and Surgical Journal*, August 26, 1897, there is reported a discussion before the Obstetrical Society of Boston upon anæsthesia in obstetrics. The practical points regarding the use of ether and chloroform are fully treated.

Ether and chloroform in normal labor are the subject of a thorough paper by Bukoemsky, in the *Monatsschrift für Geburtshilfe und Gynäkologie*, 1896, Band 3, Heft 3.



of the uterus and then expelled, post-partum hemorrhage will often be avoided. So long as the womb remains contracted and there is no bleeding the physician should wait after the delivery of the child until the patient gives evidence that the uterus is ready to expel the placenta. Her efforts may be reinforced by pressure applied upon the anterior and posterior walls of the uterus, when the placenta should readily be removed. Pulling upon the cord, rapid and hasty efforts to remove the placenta, or rough manipulations of the uterus are unnecessary and injurious.

As soon as the uterus is empty it is customary to give ergot, and there can be no good objection made to this procedure. Some prefer to administer ergot as soon as the child is born and before the placenta is delivered. In our experience, however, it is better to wait until the womb is empty, controlling its condition after the expulsion of the child by the hand. The fluid extract of ergot is most efficient, used in doses of 1 drachm. In our experience ergot should be given to produce a desired effect. We have seen 4 drachms given in two hours without serious result.

While the administration of ergot by the mouth is usually satisfactory, in critical cases this method should not be employed. In a patient exhausted by hemorrhage, depressed, nauseated, and badly frightened, the administration of ergot by the stomach is too slow and unreliable for the needs of the case. The drug must be used hypodermatically to secure the desired result. Suitable preparations of ergot are obtainable especially adapted for this purpose. Ergotine and aseptic ergot are those usually employed. We keep them in constant readiness during cases of labor and often employ them.

Ergot is usually given for relaxation of the womb which threatens hemorrhage after labor. More prompt and satisfactory results can often be obtained by the hypodermatic use of strychnia in these cases. From  $\frac{1}{30}$  to  $\frac{1}{15}$  grain of sulphate or phosphate of strychnia may be given so soon as the womb is empty. In cases of hemorrhage,  $\frac{1}{100}$  grain of atropine may be combined with strychnia to advantage.

In cases in which the patient is restless and profoundly depressed by hemorrhage the use of opium has long been practised for the prevention of further hemorrhage. Morphine or codeia, with or without atropine, may be employed, and stypticin may also be used. This treatment is best available at the time when the immediate hemorrhage has ceased and when the patient is beginning to react, and when the nervous system needs a tranquillizing agent.

It must be remembered that in the third stage of labor exhaustion is the great danger which may develop, and that the physician must also have in mind the prevention of this serious complication.

Syncope may develop readily and occasionally prove fatal. It is imperative then that the physician should have ready at all cases of labor strychnia and atropia, alcoholic stimulants, and hot water, for the treatment of this condition. The danger is readily prevented, but is a difficult one to control when fully developed.

The treatment of the third stage of labor demands that the physician should personally assure himself that no laceration of the genital tract has occurred which requires repair. He is personally responsible for the finding out of this condition, and in most cases for its repair. Every physician who practises obstetrics in the present stage of obstetric science cannot escape the responsibility of examining and endeavoring to repair injuries caused by labor. The technical skill required for the performance of this operation, while considerable in difficult cases, is still within the range of the average practitioner, and with the education now given in our medical colleges students are properly taught to perform this manipulation.

#### ASEPSIS AND ANTISEPSIS.

No consideration of the treatment of labor can be at all adequate which does not seriously consider the question of asepsis and antiseptis.

From a large mass of evidence we believe that the genital tract of the healthy woman is aseptic, and that the secretions present before labor in such a patient are not only not harmful, but have also germicidal properties. Vaginal douches before labor are injurious and should not be given. After labor is completed, as a matter of precaution lest some septic matter may have been carried into the genital tract by the hand or instrument of the physician, it is proper to douche the vagina and cervix once thoroughly with bichloride solution (1:4000). In healthy patients delivered under aseptic precautions no further douching is indicated. The parturient patient should wear antiseptic dressings impregnated with bichloride of mercury (1:2000), and the lochial discharge should be entirely received by such dressings. These should be changed sufficiently often to keep the patient surgically clean. At each changing the external parts only should be thoroughly irrigated with bichloride solution (1:4000), and no douche should be given. Soiled dressings should be burned. The breasts and nipples should be covered with sterile dressings, and the nipples cleansed before and after nursing with a saturated solution of boracic acid. After micturition and defecation the external parts should be thoroughly cleansed with bichloride (1:4000), and fresh dressings applied.

While the physician may trust in normal cases to rigid asepsis on his part, it is safer to employ antiseptic precautions regarding his



hands, instruments, and dressings. Thorough cleansing of the hands with soap and hot water, followed by hot water only and then with bichloride solution (1:2000), the use of biniodide of mercury and glycerin (1:500) as a lubricant, the employment of perfectly clean or sterile linen about the patient, and the thorough cleansing of the external parts with bichloride solution are all indicated as antiseptic precautions. Instruments used during labor should be boiled for twenty minutes at least, and physicians should carry simple sterilizing apparatus, so that they are entirely independent of domestic utensils for the sterilization of their instruments. By diagnosing the case through palpation and auscultation with pelvimetry the number of vaginal examinations is reduced to a minimum, and the risk of infection thereby lessened. Among the physician's outfit should be a glass douche-tube, boiled with the other instruments, so that the douche given after labor may be given with sterile apparatus. The ligature for the umbilical cord should be boiled with the other appliances. In difficult labors the maintenance of asepsis is naturally more complicated. When lacerations occur the parts must be closed with aseptic suture material and with sterile instruments; and the after-treatment of these patients requires the cleansing of the stitches with dilute antiseptic solutions at regular intervals and the employment of antiseptic dressings. In obstetric operations the same care in obtaining asepsis is necessary which is incumbent upon the operator in other surgical procedures. When hemorrhage is threatened and it is necessary to douche the uterus, sterile water or dilute lysol solution made with sterile water may be employed. If the womb be packed with gauze, the gauze must be surgically sterile and also impregnated with iodoform. In every detail of obstetric work thorough asepsis regarding the patient and thorough antiseptics regarding the physician must be faithfully followed. There is room for vast improvement in the aseptic conduct of labor in private houses. The time has passed when the physician should boil his instruments in pots and kettles. He would not go to a house to amputate a leg or remove a breast trusting to domestic utensils for sterilization. The same precautions which such an operation requires should be taken when the forceps is applied or any other obstetric operation is undertaken. There are simple appliances sufficient to maintain the patient in the best posture for operating, thus dispensing with a large number of assistants, and for convenient sterilization of instruments, so that no reasonable excuse remains for negligence in this matter.

The use of antiseptics in puerperal conditions requires proper discrimination and caution. There is abundant evidence that solutions of bichloride of mercury when introduced within the uterine cavity may cause fatal poisoning. Patients are occasionally seen who are



so susceptible to the action of mercury that vaginal douches produce partial mercurial intoxication. It is our rule not to employ bichloride of mercury within the uterus, and when intrauterine cleansing is necessary to use normal salt solution or lysol (1 per cent.). The uterus seems very tolerant of iodoform. We have not seen iodoform-poisoning follow the introduction of this substance in suppositories or the packing of the uterus with iodoform gauze. Cases are occasionally seen in which cleansing the external parts with bichloride solution produces irritation of the skin, especially in women of very light complexion and very delicate tissues.<sup>1</sup>

#### PUERPERAL SEPTIC INFECTION.

In spite of the adoption of antisepsis and asepsis in surgery and medicine puerperal septic infection is not uncommon, and a very considerable mortality from this cause is constantly observed. This results from two sources: first, a disregard of what is known concerning the causation and prevention of septic infection; and, secondly, the improper and injudicious use of antiseptic substances.

Puerperal septic infection does not arise within the body of the patient, but its original focus has always been conveyed from without. It is especially likely to occur in cases of prolonged, difficult, and neglected labor, in which the patient's strength is exhausted before delivery, or in which some disproportion exists, which makes laceration of the genital tract inevitable. Cases in which frequent manipulation within the vagina is practised are especially liable to develop septic infection.

Fever, rapid pulse, foul lochial discharge or cessation of lochial discharge, pain and tenderness in the abdomen, a large and flabby uterus, a furred and coated tongue, with general prostration, form the clinical picture of puerperal sepsis. The treatment of this condition must be local and general.

So soon as the diagnosis is made the genital tract of the patient, from the fundus of the uterus to the vulva, should be thoroughly explored and made as clean and aseptic as possible. For exploration the fingers should be employed, and they form the best instrument, so far as their power to reach goes. Thorough exploration of the uterus, however, is rarely possible in these cases without the employment of some instrument, preferably a curette. This cleans-

<sup>1</sup> "The Maintenance of Asepsis during Labor" receives treatment by Acconci, *Annali di Obstetricia*, Jan., 1896.

Jewett (*American Journal of Gynecology*, April, 1896) contributes an interesting paper upon puerperal self-infection.

At the International Congress of Gynecology and Obstetrics, Amsterdam, Aug. 8-12, 1899, a discussion took place upon the relative value of *methods of antisepsis*. A report of this discussion is found in the Transactions of the Congress.

ing and exploring of the genital tract should be so thoroughly done that it will probably not be necessary a second time. If the patient be frightened and suffering from considerable pain, it is well to anaesthetize her with ether. If she is not especially nervous and is not suffering from pain, it is not always necessary to use an anaesthetic.

The external parts should be thoroughly cleansed with soap and water, with water, and then with bichloride solution (1 : 2000). The patient should be placed in the dorsal position at the edge of the bed or table, with her limbs so adjusted as not to impede the work of the operator. The vagina should be thoroughly douched with bichloride solution (1 : 4000), and the pelvic floor should be examined to determine the presence of ulcers or other lesions. If the patient has had a laceration and stitches have been taken, it will usually be found that union is not taking place, and that pus is forming between the lines of incision. These stitches should be taken out in such a case, and the wound allowed to gape open so that it may be disinfected from the bottom.

When the vulva and vagina have been thoroughly cleaned, the cavity of the uterus should next be explored. The neck of the womb is sometimes so firmly contracted as to make the entrance of a curette or of the finger impossible. Under these circumstances the cervix should be dilated, using a solid dilator for this purpose. If possible, the uterus may be explored with the finger to determine the presence or absence of placenta or membranes, and such should be removed if it can be done by the finger. In most cases, however, the finger is not long enough to explore the womb completely, and a curette should be employed. Our preference is a douche curette through whose hollow handle a stream of 1 per cent. lysol at a temperature of 110° F. constantly flows. The edge of the curette is not sharp, but resembles that of a paper-cutter. With this instrument, while the antiseptic solution flows freely, the interior of the uterus may be thoroughly explored and emptied of all decomposing material. Diseased decidua should be scraped away, and the physician should assure himself that the womb is thoroughly emptied. If hemorrhage follows this curetting, the uterus may be tamponed to advantage with iodoform gauze. Should bleeding not occur the use of the gauze is not necessary. We have seen good results in some cases from placing within the uterus after curetting a suppository containing 60 grains of iodoform. If gauze be used, it should be removed in from twenty-four to thirty-six hours, and the uterus gently but thoroughly washed out with normal salt solution or with lysol (1 per cent.). To wash out the uterus we use a glass tube especially adapted to the purpose. It is far preferable to metal tubes, whose construction is not simple and which give abundant lodging-



places for bacteria and for pus. Repeated intrauterine douches are extremely harmful. They constantly set free infectious and decomposing material and promote its absorption into the lymph-vessels of the uterus. If the womb be thoroughly cleansed under an anæsthetic, the uterus need not again be douched unless packing has been employed, when a single washing out is quite sufficient.

It is of great importance in puerperal septic cases that the uterus be made to contract as firmly as possible, that thereby the drainage of the womb be promoted. Tonic doses of strychnia assist greatly in this in combination with moderate doses of ergot. If the womb is retroverted, its position should be corrected that its drainage may not be interfered with.

For the pain and fever from which these patients suffer the use of cold is especially efficacious. An ice-bag may be placed upon the abdomen or an ice-poultice be fitted over the lower portion of the abdomen to great advantage. If severe pain be present, a turpentine stupe of ice-water may be first applied, and over this an ice-bag. This method of treatment often renders the use of narcotics unnecessary.

The lymphatics of the general peritoneal tract should be drained as rapidly as possible by saline purgation. A saturated solution of sulphate of magnesium or of Rochelle salt should be given from every half hour to every hour until the bowels have moved very freely. If the tongue be heavily coated, calomel and salts will be found of advantage.

The patient's strength must be maintained, and her nourishment provided by the use of stimulants and of liquid or predigested food. The best stimulants are whiskey and brandy, and they should be taken to the full limit short of intoxication. Broths, soups, peptonized milk, eggs beaten up with whiskey, and any other article of liquid diet which the patient may crave must be taken in abundance. The patient should be given liquid food at regular intervals, and if she be much oppressed by fever food can best be administered after a bath, a sponge, or pack, when appetite is improved by the reduction of temperature. An abundance of water must be taken, and care should be exercised to avoid the use of the catheter, if possible, lest the bladder become infected.

Scrupulous cleanliness is necessary in the care of these patients to avoid the production of bedsores. The patient should be turned frequently but very gently upon her side, and every effort made to keep her as comfortable as possible.

Under this treatment the majority of cases of puerperal septic infection grow steadily better. The temperature gradually falls, the pulse improves, the patient takes an increased amount of food, the



foul lochial discharge ceases, and recovery follows. If, however, this does not happen, but if the temperature rises or is characterized by marked fluctuation, a thorough vaginal examination should be made to determine the presence of a focus of infection within the pelvis. If a tumor be found in the pelvis, fluctuating on pressure, pelvic abscess is evidently present. This tumor should be opened through the vagina, thoroughly emptied and washed out, and a drainage-tube or packing of gauze inserted. If a circumscribed fluctuating mass be found in the abdomen, it should be incised through the abdominal wall, its contents emptied, and drainage established. Care must be taken not to break down the wall of the abscess and thus contaminate the general peritoneal cavity with its contents.

When it is evident from a persistent foul lochia that the body of the womb is extensively infiltrated the question of hysterectomy must be seriously considered.

Cases are reported in which an apparently brilliant result has followed this operation. In other patients the operation only hastened the inevitable termination of the disease. When the uterus is soft and baggy this condition gives valuable evidence of its extensive septic infiltration. In these cases vaginal hysterectomy is a desirable method of operation. Where the operator finds evidence of extensive adhesions it is well to open the abdomen, loosen or separate the adhesions, and then proceed to vaginal hysterectomy. The vaginal operation is desirable because it gives the best opportunity for thorough drainage.

Pyosalpinx following puerperal septic infection is sometimes seen. It is usually less virulent than gonorrhœal salpingitis, and cases are reported in which spontaneous but tedious recovery has happened. Should the condition persist, however, the diseased tissue must be removed. Whenever possible this should be done by vaginal incision.<sup>1</sup>

#### SUBINVOLUTION.

Subinvolution of the genital tract results from septic infection, injuries which are not repaired after labor, and assuming the upright posture before the supports of the uterus have regained their normal tone. A positive lack of vigor is also a frequent and intractable complication in these cases.

<sup>1</sup> The value of antistreptococcic serum is fully stated in the report of the Committee of the American Gynecological Society, May, 1898. This may be found in the *American Journal of Obstetrics*, vol. 40, No. 3, 1899.

The use of nuclein in puerperal sepsis is described by Hofbauer, *Centralblatt für Gynäkologie*, 1896, No. 17, and also by Joy, *Therapeutic Gazette*, 1897, No. 5, p. 296.

The writer's views upon celiotomy in puerperal sepsis are given in a paper upon the subject (*American Journal of Obstetrics*, January, 1895), in which cases are reported. Cases illustrating drainage in puerperal septic infection are reported by me in a paper published in the same journal for July, 1895.

During the puerperal period much can be done to obviate this condition. If infection be avoided, lacerations be closed, and the action of the intestines be stimulated, this will greatly help in securing proper involution. Care should be taken that the patient frequently changes her posture in bed, and that the uterus drains as thoroughly as possible. After the first few days the patient should turn upon either side or lie upon the stomach as often as is comfortable. When the lochial discharge begins to lessen she may leave her bed to use a commode. Drainage is thus increased, and if the patient be not chilled involution is distinctly promoted. She must not, however, assume her usual occupations until the womb has become a pelvic organ and the lochial discharge has ceased. Before the patient is discharged her physician must examine her to ascertain the position and condition of the uterus, and, if necessary, some form of support may be worn for a short time.

In cases in which general debility and deficient strength hinder the process of involution general massage is of the greatest value. It may be begun at the end of the second week and continued for a month. If the masseuse has been properly trained to employ pelvic massage, she may practise external massage of the pelvic organs with decided benefit to the patient.

Subinvolution is often accompanied by a considerable degree of anæmia. This must be combated by the use of saline laxatives, the administration of Fowler's solution, suitable preparations of iron, and tonics addressed to the digestive organs.

When the patient's general vigor is deficient, she will not successfully perform the function of lactation. If examination of the breast-milk shows it to be deficient in the natural constituents, the nursing cannot be continued in the interests of the child. If the breast-milk be normal, an effort may be made to continue nursing while stimulating the mother in all possible ways. When the mother is able to take fresh air her general condition may so improve that she can continue to nurse her child.

#### POST-PARTUM HEMORRHAGE.

Post-partum hemorrhage, like puerperal septic infection, is largely preventable, and hence should be of rare occurrence. We have already outlined those methods of treatment which usually succeed in preventing it. In the presence of hemorrhage, however, we find the following method of treatment successful in the large majority of cases :

The uterus must be massaged until it can be distinctly outlined, when it is grasped firmly by the hand, the four fingers passed deeply behind the uterus, and the thumb pressed firmly in the centre of



the anterior wall of the womb. At the same time the uterus is carried downward and forward in the pelvis.

A vaginal douche of one gallon of sterile water at a temperature of 110° F. is given as soon as possible. Great care must be exercised that the douche nozzle be sterile, and also the water used.

A hypodermatic injection of strychnia,  $\frac{1}{30}$  to  $\frac{1}{15}$  grain, is given as soon as possible, and also a hypodermatic injection of aseptic ergot or ergotine. We are accustomed to fill the barrel of the ordinary hypodermatic syringe with either of these preparations of ergot.

In 90 per cent. of cases this treatment promptly stops the hemorrhage. Should it fail, the patient should be placed at the edge of the bed, a fresh supply of sterile water obtained, the hands of the physician carefully sterilized and also the douche-tube, and the uterus should be thoroughly washed out with sterile water at 110° F. No violent effort should be made to remove adherent clots from the womb, but a large clot should be turned out and the uterus thoroughly douched. If a tendency to bleeding persists, the womb is tamponed with iodoform gauze. The vagina is thoroughly washed out and is tamponed with bichloride gauze.

It is very rare that hemorrhage persists after this treatment has been efficiently carried out. Should the womb not remain properly contracted we repeat the strychnia and ergot. The nurse is instructed to hold the womb gently, but firmly, massaging it without violence when it is felt to relax. When the uterus remains contracted, but not until then, three rolls are made with folded towels. One is placed across the abdomen at the fundus of the uterus and one upon each side of the womb. A binder is then pinned snugly around the abdomen, beginning from above and pinning down toward the pubes.

If the patient requires active stimulation a rectal injection of one ounce of freshly made strong coffee, one ounce of whiskey, and three ounces of warm water may be given. Intravenous transfusion of normal salt solution is exceedingly valuable. But one hesitates to employ this treatment without positive indication, because it is not easy to transfuse a patient who is not anesthetized or partially unconscious. Hypodermoclysis with normal salt solution may often be performed more readily than intravenous transfusion. The foot of the patient's bed should be so raised that the patient is practically very nearly inverted. To secure this it is best to place the legs of the bed on chairs, or to place a table beneath the footboard. Artificial heat is best applied beneath the base of the brain by placing beneath the back of the patient's neck a hot-water bottle covered with a towel. Rectal injections of whiskey and water alternating with nutrient enemata are required. To stimulate the patient's respiration, atropia is valuable in doses of  $\frac{1}{100}$  grain. If the womb shows a constant tendency to



relax, the faradic current of electricity, one pole placed over the womb and one over the lumbar region of the spine, will be found of great value.<sup>1</sup>

#### PUERPERAL MASTITIS.

The greater number of cases of this complication of the puerperal state can be prevented by strict antiseptic precautions during and after labor. In a considerable number of patients pus-forming bacteria are present in the milk-ducts of the breast before the patient has nursed the child, and it is not difficult to understand how stasis and retention of milk so contaminated may result in the formation of mammary abscess. To prevent breast-abscess, not only must the patient not be infected from without, but the drainage from the breast of its natural secretion must be thoroughly accomplished. Cracks and fissures of the nipple may be kept aseptic by the use of borated dressings held in place by a suitable bandage. If the child's mouth be carefully cleansed before nursing, it will not inevitably infect the mother's breast. In many cases the mother can nurse through a nipple-shield, and thus infection be avoided. If a cracked or fissured nipple be kept thoroughly clean, it may be healed without interrupting the nursing of the child or without disturbance. If the drainage of the breasts be interfered with and milk accumulates, forming what is known as caked breast, this condition must be relieved by massage, the use of the breast-pump, or by both. Massage is most efficacious when combined with the use of warm sterile olive oil. The manipulation must be gentle, commencing at the periphery and proceeding with light strokes toward the nipple. The use of the breast-pump must also be gentle, and by the use of the pump with massage it is usually possible properly to empty an over-filled breast.

If, however, the patient has fever, pain and hardness in the breast, absolute rest, saline purgation, and the use of an ice-bag upon the breast will be found efficient in checking a beginning inflammation. The diet of the patient must be limited and liquids be taken in small quantities only.

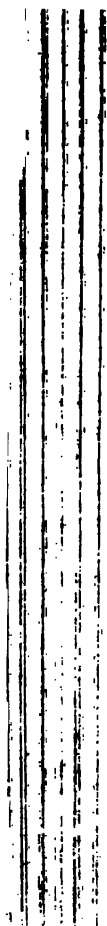
If a temperature of 102° F. or more is present upon several occasions, we must suspect the formation of pus. If this has happened, incision and drainage form the only method of efficient treatment. Under ether an incision should be made over the most painful spot

<sup>1</sup> The prevention of post-partum hemorrhage is described by Atthill (*British Medical Journal*, 1897, No. 1888). He uses tonic doses of strychnia and ergot for a short time before labor begins. Secondary puerperal hemorrhage was discussed at a meeting of the British Medical Association, at which Routh read a paper upon the subject (*Ibid.*, October 24, 1896).

The use of stypticin in treating puerperal hemorrhage is described by Falk, of Berlin, in the *Monatsschrift für Geburtshilfe und Gynäkologie*, 1899, Band 10, Heft 4.

in the breast, parallel with the course of the milk-ducts. The finger should be introduced and the breast thoroughly examined, the finger breaking down the partition-walls between small abscesses and converting the suppurating portion of the breast into one abscess-cavity. A counter-opening should be made, the parts thoroughly washed out, and drainage-tubing passed through the breast. This should be removed at the end of twenty-four hours and the lower openings in the breast be kept open by plugs of iodoform gauze. The sinuses must be irrigated daily or every two days until union occurs.

Confusion sometimes arises from the presence of suppuration deep beneath the breast. Cases are sometimes seen in which pus burrows under the fascia upon which the breast rests and makes its way among the fibres of the pectoral muscles. In these cases the entire breast is raised although a distinct sense of fluctuation cannot be obtained. It is here necessary not only to explore the breast should an abscess be there present, but also to incise the side of the breast through the fascia, thus coming upon the site of the suppuration. In neglected breast-abscesses, in which pus burrows extensively, the axilla may become involved, and it may be necessary to open and drain this portion of the body.





# DISEASES OF THE EYE AND THEIR TREATMENT BY THE GENERAL PRACTITIONER.

By CASEY A. WOOD, M. D.

## GENERAL CONSIDERATIONS.

IN recent years experience has to some extent modified the views that were once held as to the value of that long list of remedies which the surgeon had come to regard as necessary in the treatment of ocular affections. Our faith in the efficacy of many of them has, it is true, been confirmed, but in the case of others either we do not employ them to the same extent as formerly or we do not use them at all. This attitude proceeds from the conviction that results supposed to flow from the exhibition of the older remedies may be obtained by other, simpler, less expensive, or less painful means, or that more harm than good is done by employing them in ophthalmic practice.

As to the remedial agents that have appeared during the past four or five years, some will probably be retained as being specially effective in the treatment of eye-diseases, but, just as in other departments of medicine and surgery, certain agents at first loudly and authoritatively recommended, not having stood the test of time and experience will eventually be consigned to the oblivion they deserve.

Finally, new applications of old remedies are being constantly advised.

In these pages particular attention will be paid only to those drugs and appliances of recent vogue that seem to be most effective.

*A transient dilatation of the pupil* without material disturbance of sight can be best accomplished (in about half an hour) by instilling three times a drop of the following solution every two minutes :

Euphthalmin hydrochlorate,	
Cocain hydrochlorate,	of each $2\frac{1}{2}$ grains (0.15) ;
Distilled water,	$\frac{1}{2}$ fluidounce (15.).

This is a very useful agent in the examination of the lens, in searching for posterior synechiæ, determining the character of the pupillary dilatation, and in making the ordinary examination of the fundus oculi.

*Cleansing of the ocular structures as a preliminary to operations* is regarded as of greater importance than ever. Elaborate experiments have shown that—(1) It is practically impossible to absolutely sterilize the conjunctival sac, the lachrymal passages, the eyelashes, or the lid-margins. (2) When powerful antiseptics are employed with this object in view the vascular disturbances set up by them largely neutralize any good that the resulting antiseptics may have brought about. (3) The most effective and least injurious agents are those that, acting mechanically, remove the pathogenic organisms, reduce their numbers, and weaken their power for evil. Thus, copious irrigations of the eye with mild sterilized aqueous mixtures with formalin (1 : 5000-3000), or of solutions of common salt (1 per cent.), boric acid (4 per cent.), sodic bicarbonate (1 per cent.), or sodic biborate (4 per cent.), or with sterilized water alone, are much to be preferred to the employment of strong mercuric chloride, iodide, or cyanide solutions, although these latter are much more potent as bactericides.

For the disinfection of scissors, needles, knives and other cutting instruments the writer prefers their immersion for fifteen minutes in the following mixture :

Pure carbolic acid,	12 ounces (375.) ;
Glycerin,	8 ounces (250.).

This should be kept in a convenient, covered vessel, and the instruments must be removed, after immersion in the phenol mixture, to a pan filled with sterilized water.

For the purpose of limiting the area of possible infection as much as possible, and as far as is consistent with the effective use of the hands, the ophthalmic surgeon's gown should be tied with draw-strings at the wrists close to the base of the thumbs. The less hair he has exposed upon his head and face the more thoroughly the operative area is cleansed, and the less frequently he touches it with his fingers the more satisfactory will be the results of the impending operation.

Wilson of Detroit advises the following preliminary precautions :

1. The skin surrounding the eye should be well cleansed with sterile, neutral soap and water.
2. The eye should be thoroughly irrigated with a warm 1 per cent. solution of common salt.
3. The instruments are to be immersed in boiling water for a few seconds and then wiped dry with a soft sterilized towel.
4. The operation should be made as rapidly and accurately as possible.
5. The wound should then be irrigated with salt solution ; and
6. The subsequent dressings sterilized by heat only.

7. When possible do not disturb the dressings until primary union has occurred.

8. The patient's general health should receive the utmost attention before, during, and after the operation.

### DISEASES OF THE CONJUNCTIVA.

INFLAMMATION of the conjunctiva is of special importance because, in its various forms, it is the commonest disease of the eye. In the majority of instances this inflammation is due to infection by pathogenic micro-organisms and their toxins. No doubt mechanical abuse, vasomotor disturbances due to changes of temperature, dust, smoke, and wind predispose to attacks, but bacterial invasion stands as the exciting cause of this as well as of many other inflammatory diseases of the eye. Recent investigations have shown that even the healthy conjunctiva, the lid-edges, the cilia, and the palpebral skin are a favorite resting-place for some thirty kinds of microbes, including almost all the organisms, innocent and pathogenic, that infect the rest of the body. The moment the resistance of the tissues is sufficiently reduced there is always at hand a supply of these agents ready to set up a conjunctivitis of some kind or other.

The importance of the differential diagnosis between certain common inflammatory affections of the ocular structures, especially between acute conjunctivitis, acute iritis, and acute glaucoma, cannot be over-estimated. To mistake one of the last two of these diseases for a conjunctivitis is to be a party to the production of blindness in the patient under observation, and yet such a fatal error is not uncommonly made. The accompanying table of symptoms will assist the practitioner in his efforts to treat successfully any of these acute inflammations:

ACUTE CONJUNCTIVITIS.	ACUTE IRITIS.	ACUTE GLAUCOMA.
<i>Pain:</i> Little or none. Foreign-body sensations.	Severe, supraorbital pain, getting worse toward night.	Very severe and neuralgic in character. Is referred chiefly to the supraorbital branches of the fifth nerve. The scalp of the affected side often feels sore to the touch.
<i>Discharge:</i> Mucous and mucopurulent, or as flakes of lymph.	Profuse and watery.	Scanty, and fluid in character.
<i>Vision:</i> Not affected, or only slightly impaired.	Affected from the first.	Greatly impaired. Halos appear about lights. Foggy vision.



ACUTE CONJUNCTIVITIS.	ACUTE IRITIS.	ACUTE GLAUCOMA.
<i>Pupil:</i> Reacts promptly to light and accommodation. Presents the normal size and appearance.	Contracted; sluggish, or immovable.	Widely dilated, motionless, and of a greenish hue.
<i>Photophobia:</i> None.	Always more or less marked.	Present, but not so marked as in iritis.
<i>Disease affects:</i> Both eyes in the majority of cases.	Often one eye only.	Usually one eye only.
<i>Change in iris:</i> No change in color or other appearance.	Discoloration, with loss of velvety gloss. Sometimes lymph-deposits on its surface.	Loses its brilliant gloss.
<i>Posterior synechia:</i> None.	Commonly present.	None, unless secondary iritis has occurred.
<i>Injection of bulbar vessels:</i> Coarse congestion of vessels.	Fine pericorneal injection.	Congestion of the episcleral veins as well as pericorneal injection.
<i>Lachrymation:</i> Little or none.	Abundant flow of tears.	Not so marked as in iritis.
<i>Morning adherence of lids:</i> Almost invariably occurs.	None.	None.
<i>State of conjunctiva:</i> Swollen, opaque, and roughened.	Slightly hyperæmic, but transparent in early stage of disease.	Slightly hyperæmic palpebral conjunctiva.
<i>Cornea:</i> Unaffected.	Rarely hazy.	Hazy; anterior chamber shallow.
<i>Intraocular tension:</i> Normal.	Rarely much increased.	The eyeball is decidedly harder than normal.
<i>Tenderness on pressure:</i> None.	Marked.	Often absent.

Catarrhal conjunctivitis, also known as simple, acute, or mucopurulent ophthalmia, is best treated by simple and non-irritant applications, particularly when there is discomfort, pain, or photophobia present.

Gentle irrigation with weak solutions has been generally recommended in recent years and its results are often quite marked. The reservoir of the irrigator is filled with the warmed and sterilized fluid and placed not more than a few inches above the head of the recumbent patient. A steady stream, directed from one canthus to the other, flows over the diseased parts into a pan placed to catch it. The following are the solutions commonly employed:

Formalin,	3 minims (0.20);
Sterilized water,	1 quart (1000.).

The eye to be gently irrigated four times daily. Apply to the lid-edges at night:

Calomel,	1½ grains (0.10);
Lanolin,	150 " (10.).

Another irrigating solution :

Sodic chloride,	75 grains (5.);
Sterilized water,	1 pint (500.).

Still another :

Sodic biborate,		
Boric acid,	of each 4 drachms (15.);	
Boiled water,	1 pint (500.).	

A very useful one when much pus is secreted is—

Chlorine water,	12 drachms (50.);
Sterilized water,	1 quart (1000.).

In the later stages of the disease the following is of value and should be dropped into the eye three times daily :

Antipyrin,	7 grains (0.40);
Distilled water,	2½ drachms (10.).

When there is much mucous discharge nascent argentic iodide has been highly recommended. This is made from—

- |                                   |                    |
|-----------------------------------|--------------------|
| I. Potassic iodide,               | 50 grains (3.32);  |
| Distilled water,                  | 50 minims (3.60);  |
| Pure glycerin,                    | 100 minims (6.50). |
| II. Silver nitrate, crystallized, | 50 grains (3.56);  |
| Distilled water,                  | 50 minims (3.50);  |
| Pure glycerin,                    | 100 minims (6.50). |

Mix 2 drops of solution II. with 3 drops of solution I. and brush the conjunctiva of the averted lids thoroughly with the freshly precipitated silver iodide.

Another mixture that acts very nicely when there is much secretion present is *finely powdered thioform* (dithyosalicylate of bismuth), flecked with a camel's-hair brush upon the cleansed conjunctiva lining the lids. Gallicin, dusted into the eye in the same way as the preceding and for the same purpose, has been recently advised, but this agent causes considerable pain and should not be used unless the eye has been previously cocainized.

When the mucous membrane is rough and secreting freely, it may be touched lightly, after cleansing, by means of borated cotton wound on a probe or wooden toothpick, saturated with the following :

Mercuric cyanide,	15 grains (1.);
Distilled water,	3½ ounces (100.).

This should be immediately washed off with distilled water.

Panas has lately advised the following to be used as a lotion in the second stage of simple acute conjunctivitis :

Beta-naphthol,	15 grains (1.);
Alcohol, enough to dissolve this in	
Distilled water,	1 quart (1000.).

It should be freely applied with a medicine-dropper.

A moderate irrigation of the conjunctival sac may be obtained by using a large pipette, and a number of useful agents may be thus applied to the inflamed surfaces in this disease. A very effective solution for this purpose is—

Sodic sulphate,	75 grains (5.);
One p. ct. sol. common salt,	8 ounces (250.).

This should be instilled, when quite warm, four or five times daily.

In every case of catarrhal conjunctivitis a simple ointment should be applied to the lid-margins at night, to be washed off in the morning. One of the best of these is—

Lanolin,	3 drachms (12.);
Oil of almonds,	
Distilled water,	of each ½ drachm (2.);
Attar of rose,	1 drop.

Purulent conjunctivitis, most commonly observed as *ophthalmia neonatorum* and *gonorrhœal ophthalmia*, is best treated in the early stages by soothing applications and iced gauze.

The strictest cleanliness of the internal ocular structures should be observed. *Careful irrigation of the sac with mild antiseptic solutions* constitutes the most effective adjunct to other forms of treatment. Take a clean, small-sized "fountain" syringe. To the end of the rubber tube attach the glass terminal of a common, straight medicine-dropper. Fill the bag with the following mixture, warmed to about 40° C. (104° F.):

Borax,	
Boric acid,	of each 2 ounces (60.);
Solution of mercuric chloride	
(1 : 20,000),	10 fluidounces (300.).



This forms a mild, non-irritating solution. Hold the bottom of the bag three inches above the level of the child's face (held in the recumbent position) and use about 4 ounces for each eye, carefully directing the stream against the borders of, first, the lower and then the upper lid, carefully drawing the latter with the fingers as far away from the cornea and globe as possible. The stream should not *directly* irrigate the corneal surface. To touch the cornea with the irrigating tube, camel's-hair pencil, cotton wads, or fingers is to invite ulceration of the cornea and blindness. Both surgeon and nurse should exercise the greatest care and gentleness in opening the lids and applying the remedies. Frequent cleansings are better than strong caustics.

So far as drugs, in the stage of profuse discharge, are concerned, the mixture recently introduced by X. C. Scott is recommended :

Hydrastine sulphate,	
Boric acid,	
Borax,	of each 5 grains (0.35);
Tincture of opium,	$\frac{1}{2}$ drachm (2.);
Distilled water to make up	1 fluidounce (30.).

Mix and filter.

To be instilled into the eye frequently.

Instead of using silver nitrate, Hoor and others recommend argentamin (ethylendiamin-silver-phosphate) as having greater powers of penetration and as being consequently more effective than the nitrate. A 5 per cent. solution is to be thoroughly brushed over the everted lids as often as is desired. Hoor says of it, after many experiments, that the result of treatment was at least what might have been expected from silver nitrate, but that it should be used in solutions from three to five times stronger than the lunar caustic. He further claims that it possesses all the advantages of silver nitrate and none of its disadvantages; it may be applied in the presence of corneal complications, and is even well tolerated in inflammatory states of the iris and ciliary body. Like most other salts of silver this phosphate preparation should be kept in a dark bottle. Examples of numerous, recent substitutes for argentic nitrate are protargol, argonin, and metallic silver. The former is employed in 5 to 20 per cent. solutions in the same manner as the other silver salts.

When Buller's shield (a watch-glass set in a window made in a patch of adhesive plaster and applied so that the former comes directly in front of the sound eye) is used to prevent infection, the purulent discharge is still more effectively shut out if a thin strip of absorbent cotton be moistened with collodion and attached over the edge of the plaster.

Reich-Hollender advises a lotion and cold compresses of

Chlorhydrate of quinine,	15 grains (1.);
Distilled water,	3 ounces (90.).

To be used as an adjunct to other treatment, especially after the eye has been thoroughly irrigated with some of the weak lotions previously mentioned as being valuable in the catarrhal form of conjunctivitis.

When the swelling and vascular injection of the lids have somewhat subsided instillations of the following may be made with advantage :

Tannin,	23 grains (1.50.);
Distilled water,	5 drachms (20.).

Heinz advises, instead of the offensive iodoform, that *finely powdered dermatol* (basic gallate of bismuth) be blown upon the everted lids, or be applied in the pencil form.

The following mixture has recently been employed in France as an irrigating fluid—as soon as the discharge becomes profuse. It is not intended to be used alone, but is more efficacious as a bactericide than the simple solutions mentioned under the heading *Simple Catarrhal Conjunctivitis* :

Labarraque's liquid,	30 minims (2.);
Distilled water,	3½ ounces (100.).

Like other irrigating liquids it should be used warm—twice a day.

Kalt has had considerable experience with calcic permanganate, which he considers effective and non-irritating. He advises 1 gramme to 3 litres of water at 25° C. One eye to be irrigated with one-half of this two, three, or four times daily, as required. One or two additional irrigations with warm sterilized water may also be employed.

When pain is present ten drops of the following may with advantage be added to any of the irrigating fluids used in the treatment of this serious disease :

Extract of opium,	15 grains (1.);
Glycerin,	
Distilled water,	of each 30 minims (2.).

Ten drops are to be added to each litre of the fluid in the irrigator.

Browne has had signal success in treating conjunctival blenorrhœa with the following solutions, and he has found that they act quickly and satisfactorily :

- I. Magnesian trichlorophenolate, 15 grains (1.);  
 Distilled water,  $3\frac{1}{2}$  ounces (100.).
- II. Magnesian trichlorophenolate, 30 grains (2.);  
 Distilled water,  $3\frac{1}{2}$  ounces (100.).

As soon as the stage of suppuration sets in, irrigation of all the parts in the conjunctival sac (especially *under* the lids) should be made twice a day with solution II. As the swelling and discharge subside somewhat this should be continued with solution I. The irrigations should be kept up for a quarter of an hour on each occasion.

Finally, in conjunction with the application of silver salts directly to the diseased conjunctiva, there is probably no better irrigating fluid than—

- Formalin,  $\frac{1}{2}$  ounce (15.);  
 Distilled water,  $1\frac{3}{4}$  pints (800.).

This mixture is non-irritant and is a very active destroyer of pyogenic bacteria.

**Trachoma**, or true granular lids, must of course be treated with reference to its complications, and to the form of the disease. Above all, it must not be forgotten that the acute manifestations of this formidable affection are usually aggravated by astringents recommended in the chronic forms. In the acute exacerbations of the common form of the disease, where a considerable discharge is noted, the modern treatment is that of simple acute conjunctivitis. Iced compresses soaked in—

- Boric acid,  
 Borax, of each 75 grains (5.);  
 Rose-water,  $2\frac{1}{2}$  drachms (10.);  
 Distilled water,  $3\frac{1}{2}$  ounces (100.).

should be applied five or six times daily until the ocular discomfort is allayed. Exuberant granulations are best treated by expression with Knapp's forceps. Affixed to the ends of the blades of these are small creased rollers, removable for sterilizing purposes. The conjunctiva is grasped between the rollers and the follicles are effectually squeezed without damage to the mucous membrane. When this is done any of the classic astringent remedies, preferably the *lapis divinus*, may be applied to the diseased surfaces.

Sattler, of Prague, prefers *dialysed tannic acid* (*i. e.* tannin free of gallic acid) to be dusted upon the trachomatous surfaces daily.

When the lids do not show small hard granulations and there is no



marked pannus, massage of the lids upon the globe with certain ointments will be found to be of signal advantage. Either of the following may be employed in this way :

Mercurous oxide,	45 grains (3.);
Vaseline,	1 ounce (30.).

Mix thoroughly in a mortar and gently massage the eyeball once every day or so.

Dilute citrine ointment, made with brown cod-liver oil (in- stead of the official lard oil),	1 ounce (30.);
Brown cod-liver oil	2½ drachms (10.).

To be mixed with the aid of gentle heat and allowed to stand exposed to the air, but protected from dust, for a week before using. This is a smooth, semi-liquid salve, which should be introduced into the conjunctival sac on the point of a probe and used exactly like the foregoing.

When corneal complications are present, especially pannus, a watery solution of creolin has been strongly recommended :

Creolin,	15 grains (1.);
Distilled water,	3½ ounces (100.).

To be dropped into the eye twice a day alternately with 1 : 400 solution of mercuric chloride.

Diphtheria of the conjunctiva is not uncommonly seen in association with the same disease of the throat and nose, and its diagnosis should, as in suspected diphtheria elsewhere, be confirmed by the usual bacteriological examinations. Where the Klebs-Loeffler bacillus is isolated full doses of the appropriate antitoxin must be employed. This has been done with the best results.

Nicati has recently advised—

Loretin (derived from quinolin),	
Calomel,	of each 15 grains (1.);
Finely powdered boric acid,	2 ounces (50.).

This is dusted upon the infected surface while the lids are similarly treated; the whole to be covered with a sterilized cotton dressing.

Chronic catarrhal conjunctivitis sometimes follows one or more acute attacks, but is as often, perhaps, kept up by some form of eye-strain which, when possible, should be relieved. The subsequent

treatment should be a soothing one. Carter advises that a few drops of the following mixture be instilled into the eye twice a day, to be followed by one drop of a 1 : 300 zinc sulphate solution :

Boric acid,	3½ grains (0.20) ;
Cocaine muriate,	1½ “ (0.10) ;
Distilled water,	1 ounce (30.).

Massage of the lids upon the ball with equal parts of glycerin and distilled water is of considerable value. A small quantity of the following may also be employed in the same way, once a day, if it does not cause too much irritation. In the latter case the proportion of iodol is to be decreased :

Iodol,	30 grains (2.) ;
Vaseline,	2½ drachms (10.).

**Follicular conjunctivitis** must not be mistaken for trachoma, chiefly because the treatment of the former disease is simple and successful, while true granular lids, due to the invasion of the deep structures of the conjunctiva by a specific microbe, is very difficult to dislodge and its ravages so often affect the other ocular tissues. In the acute stage the enlarged follicles should be treated by iced compresses saturated with 1 per cent. solution of common salt. These applications should be made four times a day for ten minutes at a time. In the chronic form, as well as when the acute symptoms have subsided, Trousseau advises the instillation, twice a day, of two drops of the following :

Zinc chloride,	½ grain (0.01) ;
Distilled water,	75 minims (5.).

In addition to these, gentle massage of the lid upon the eyeball may be made, once every two or three days, with this ointment

Iodol,	30 grains (2.) ;
Vaseline,	
Lanolin,	of each 75 “ (5.) ;
Attar of rose,	1 drop.

## DISEASES OF THE LIDS.

**Blepharitis marginalis** is the name usually applied to a number of affections of the lid-edges that present quite different pathological pictures. Clinically, however, they may be divided into the ulcerative, eczematous, squamous, and hypertrophic.

As a rule, the majority of these yield readily to treatment. Concomitant eye-affections, especially diseases of the conjunctiva and lachrymal apparatus, should be carefully looked after. The probable existence of eye-strain should not be forgotten. The general health is not uncommonly at fault.

The following preparation of ichthyol is of signal value in most forms of marginal blepharitis:

Sulpho-ichthyolate of ammonium,	1½ grains (0.10);
Lanolin,	2½ drachms (10.).

To be applied to the borders of the lids once or twice a day.

In the squamous variety Gradle advises, to be used in the same way:

Ichthyol,	7½ grains (0.50);
Zinc ointment,	2½ drachms (10.).

Where the points of insertion of the eyelashes into the lid-margin are plainly seats of any form of the disease, these cilia should be extracted before rubbing in the salve.

In the ulcerative form Fuchs advises that the following application be smeared on a compress of fine linen and the whole fixed upon the affected eye, over night, with a bandage:

White precipitate,	2½ grains (0.15);
Vaseline,	2½ drachms (10.).

In addition to this treatment the cup-shaped and ulcerated depressions that often form in this variety of the disease should be touched, once daily, with a 20 per cent. solution of argentamin. When crusts or scales adhere to the lid-margins these should be gently removed after soaking them half an hour with borated cotton wet with sterilized hot water. In rebellious cases the ulcers may be curetted and then have applied to them this solution:

Mercuric iodide,	15 grains (1.);
Pure olive oil,	8 ounces (250.).

Mix with the aid of a gentle heat, and filter.



In eczematous blepharitis the following mixture is useful, but it must be remembered that it discolours the lashes :

Hydrogen dioxide,	1 ounce (30.) ;
Vaseline,	5 drachms (20.) ;
Lanolin,	2½ " (10.).

In cases where the lid-edges are red and irritable a very good wash, to be applied for five minutes at a time three or four times daily, is—

Lanolin,	
Gum arabic,	of each 75 grains (5.) ;
Boric acid,	15 " (1.) ;
Distilled water,	3½ ounces (100.) ;
Extract of violet,	10 drops.

This should be followed, just before retiring, by smearing the edges of the lids with—

Calomel,	½ grain (0.20) ;
Lanolin,	2½ drachms (10.).

In the simple hypertrophic form Gradle advises a mixture of resorcin and sulphur :

Milk of sulphur,	
Resorcin,	of each 15 grains (1.) ;
Vaseline,	1 drachm (4.).

A small quantity is to be applied to the lid-margins at night. In the same way may be employed this ointment :

Aristol,	15 grains (1.) ;
Vaseline,	
Lanolin,	of each 75 grains (5.).

The following formulæ are valuable in the squamous variety :

Birch oil (oleum rusci),	
Olive oil,	of each equal parts.

To be applied with a cotton swab.

Beech-nut oil,	
Olive oil,	of each equal parts.

To be applied in the same manner.

**Styes.**—Although these painful inflammatory affections of the glands supplying the lid-margin are often due to general ill health, it must not be forgotten that the exciting cause is frequently eye-strain, to be relieved only by the wearing of glasses or the correction of anomalies of the external ocular muscles. The most recent additions to the list of drugs used in their local treatment are the following :

Mercuric iodide,	7 grains (0.40) ;
Olive oil,	3½ ounces (100.).

Dissolve with the aid of heat and filter.

This should be applied several times daily to the incipient sty. A salve, to be used in the same way and for the same purpose, is—

Mercuric iodide,	½ grain (0.02) ;
Vaseline,	2½ drachms (10.).

When repeated attacks have occurred, the lid-edges should be thoroughly smeared, every day for three months, with—

Aristol,	7½ grains (0.50) ;
Vaseline,	
Lanolin,	of each 75 “ (5.).

Lanvole recommends for this purpose, also, bathing the lids regularly with—

Salicylic acid,	76 grains (5.) ;
Borax,	45 “ (3.) ;
Distilled water,	10 drachms (300.).

Or with—

Ammonium chloride,	15 grains (1.) ;
Precipitated sulphur,	45 “ (3.) ;
Spirits of camphor,	5 drachms (20.) ;
Rose-water,	1½ ounces (50.).

### DISEASES OF THE LACHRYMAL APPARATUS.

**Dacryo-cystitis**—an inflammation of the mucous membrane lining the tear-passages, especially of that of the tear-sac—may be acute or chronic, simple catarrhal or purulent. An obstruction, due either to swelling of the mucous membrane or to an organic stricture, is usually present, preventing the flow of tears into the nose. Nasal catarrh, as

productive of dacryo-cystitis, should be borne in mind. Remedies (usually operative procedures) should, consequently, be resorted to for the purpose of relieving this latter condition, while various solutions, applied with the lachrymal syringe or forced into the sac (Gould) with the tip of the forefinger, may be relied upon to reduce the swelling in the mucosa and to relieve the other inflammatory symptoms. The regurgitation of muco-pus from the lachrymal into the conjunctival sac is a common cause of catarrhal *conjunctivitis*, and that fact should be remembered in all cases of chronic catarrh of the lids.

Thomalla advises the following mixture, under the name "rhinalgin," as a suppository, twice a day, in each nostril:

Alumol,	$\frac{1}{8}$ grain (0.01);
Ol. valerian,	
Menthol,	of each $\frac{3}{8}$ " (0.6);
Cocoa butter,	15 grains (1.0).

The following solution may be injected into the sac and tear-passages in chronic cases:

Aluminium acetate,	45 grains (3.);
Distilled water,	$2\frac{1}{2}$ drachms (100.).

The irrigator is of great value in catarrhal diseases of the tear-passages, and if a blunted hypodermic needle be attached to the irrigating tube the lachrymal sac may be washed out even through the intact puncta lachrymalia. When a canaliculus has been slit, for the purpose of introducing probes or for enlargement of the passage, lavage of the diseased parts can be more readily accomplished. For this purpose there is no better irrigating fluid than—

Formol,	15 grains (1.);
Distilled water,	2 quarts (2000.).

After irrigating with a boric acid solution a small quantity of this mixture may be injected into the sac:

Antipyrin,	37 grains (2.50);
Distilled water,	$2\frac{1}{2}$ drachms (10.).

If the purulent catarrh be very marked, and particularly if it be complicated with abscess of the sac, an effective irrigating fluid is—

Potassic permanganate,	15 grains (1.);
Distilled water,	8 ounces (250.).



Duclos prefers to this a 50 per cent. solution of fluorol, which he finds much less irritating. Irrigation may be preceded by a cleansing injection of equal parts of hydrogen peroxide and water or by a 4 per cent. solution of sodic bicarbonate.

Where a fistulous opening remains after the bursting of a lachrymal abscess it may be closed by cauterization of the abnormal passage. This is well done by carrying a probe-end, armed with a little cotton dipped in lactic acid, well into the depths of the fistula. A superficial slough forms, is cast off, and the opening closes. Lately steresol (a compound resembling collodion) has been used to form a covering over the opening. This may be repeated as often as is necessary.

**Chalazion** (*retention cyst of a Meibomian tubule*).—Many authors have lately contended that strain of some portion of the ocular apparatus may, by producing hyperæmia of the lid-structures, causes these little tubules to be closed and the secretion of their corresponding glands to be retained. Apart from surgical intervention the condition giving rise to chalazia requires consideration. Massage with a simple stimulating ointment is nearly always of value in preventing stenosis of the remaining ducts in multiple cysts of this character. Darier recommends the following formula for this purpose—to be applied once daily:

Neapolitan ointment (French codex),	2 drachms (8.);
Potassic iodide,	15 grains (1.).

A simple and effective agent, for massage, is—

Lanolin,	90 grains (6.);
Oil of almonds,	
Rose-water	of each 15 “ (1.).

**Chemosis of the Lids.**—This is usually a sign of local lesion (black-eye, acute conjunctivitis, ulcer of the cornea) but may be due to cardiac disease. In any event it may be relieved by a single dose, daily, of—

Quinine sulphate,	4 grains (0.25);
Freshly powdered digitalis leaves,	2 “ (0.10).

## DISEASES OF THE CORNEA.

INFLAMMATIONS of the various structures of the cornea may be confined, in considering their etiology, to the area occupied by this membrane, but as a rule corneal inflammations form a part of processes affecting other portions of the eye, or are merely signs of general dyscrasiæ. Belonging to the latter class are two diseases almost entirely confined to children, viz. *phlyctenular keratitis* and *specific infiltration of the cornea*.

**Phlyctenular Keratitis.**—Among the various causes of this disease is acute nasal catarrh, especially the hypertrophic variety; indeed, this disease of the nose, which was at one time spoken of as a common accompaniment of the ocular affection, is now regarded as the origin of the micro-organisms (especially the *coccus flavus desidens*) that subsequently find lodgment in the conjunctiva and cornea.

In the treatment of phlyctenules of the cornea, associated with the same lesions in the bulbar conjunctiva, general hygiene, particularly in strumous subjects, is of the first importance. Indeed, there are few instances where purely local treatment is of much avail, because, if the nose or the systemic condition be neglected, one may confidently expect either a very slight improvement of the eye-symptoms or an early recurrence of the infection.

When the phlyctenules have reached the stage of ulcer each one may be touched with a match-end dipped in—

Benzo-phenonide (apyonin)	15 grains (1.);
Distilled water,	7 drachms (100.).

Then a bandage for four hours. This solution instilled into the sac, three or four times a day, is also advised :

Boric acid,	
Borax,	of each $\frac{1}{2}$ drachm (2.);
Rose-water,	$\frac{1}{2}$ ounce (16.);
Distilled water,	$1\frac{1}{2}$ ounces (45.).

Mydriatics are very useful in phlyctenules of the cornea. Instead of atropine, scopolamine (1 grain to 2 ounces of water) is effective.

Another lotion, especially when there is conjunctivitis, is—

Mercuric chloride,	15 grains (1.);
Distilled water,	5 quarts (5000.);
Alcohol,	q. s.

This is more effective when employed, three times daily, with the irrigator.

As soon as the acute symptoms have subsided the globe may be gently massaged, once a day, with—

Ammonium sulpho-ichthyolate,	1½ grains (0.10);
Vaseline,	
Lanolin,	of each 75 “ (5.).

This salve makes a useful application to the lid-margins (at night-time) and to the eczematous patches on the face that so frequently accompany the corneal and conjunctival eruption.

**Interstitial Keratitis.**—*Parenchymatous, syphilitic, specific, or strumous* disease of the cornea is merely local evidence of a constitutional disorder. It runs such an extremely chronic course and so invariably ends in more or less complete resolution that it is difficult to say what part treatment has had in determining a successful cure.

Anti-syphilitics should always be administered in cases where the specific disease, apart from the eye-lesion, is plainly marked. However, even when, in the course of months, the cornea has regained most of its transparency the patient may be found to be almost blind from disease of the ciliary body, choroid, or optic nerve. When mercury is employed it is best administered in the shape of inunctions—two grammes daily of lanolin and blue mass, equal parts. Grandclément claims that when there are no acute symptoms and the globe is not sensitive to pressure a cure results in from forty to ninety days, from massage of the eyeball daily, every two hours, with the following mixture :

Phenol,	15 grains (1.) ;
Liquid vaseline,	3½ ounces (100.) ;
Oil of wintergreen,	a few drops.

If this produce pain the eye should be cocainized before the next application. As an internal remedy the following pleasant mixture, in doses of from one to two desertspoonfuls, may be used :

Potassium iodide,	5 ounces (159.) ;
Glycerin,	1 ounce (30.) ;
Mercuric iodide,	1½ grains (0.10) ;
Syrup of quinine (Fr. codex),	6 ounces (200.) ;
Anisette (Bordeaux),	3½ “ (100.).

Hypodermic injections, repeated every two days, may be given instead of inunction, as follows :



Mercuric chloride,	1½ grains (0.10);
Sodic chloride,	15 " (1.);
Distilled water,	3 drachms (10.).

Ten to fifteen minims once daily.

For the prevention of posterior synechiæ, rotoin (from *Scopolia japonica*) is useful where atropine is contraindicated. By some authors it is claimed that this glucoside is preferable to the mydriatics usually instilled, as it does not irritate the lids even when employed for several weeks or months. A good formula is—

Rotoin,	1 grain (0.05);
Cocaine muriate,	1½ grains (0.10);
Distilled water,	1 ounce (30.).

*Punctate keratitis*, the so-called serous iritis, is usually a sign of chronic intraocular disease and should be treated accordingly. Darier has recently suggested for it the internal administration of colchicin, and gives the following prescription:

Crystals of colchicin,	1 grain (0.06.);
Sugar of milk,	1 drachm (4.).

Make into 60 granules and give from 1 to 3 daily, gradually increasing the dose until stomachic colic, or other signs of intolerance, appears. It is better to administer this remedy on alternate weeks.

**Ulcers of the Cornea.**—These may, for clinical purposes, be divided into two classes: (1) The simple, non-spreading ulcer; (2) The serpiginous or spreading variety. Both lesions are usually the result of an erosion or wound (however slight) with subsequent infection. The character and number of the micro-organisms, the resisting powers of the invaded tissues and the extent and situation of the corneal traumatism determine the severity of the disease. It is well to ascertain the area and probable depth of the ulcer by staining it with methyl violet or other reagent. The best of these is made from

Fluorescin.	4 grains (0.25);
Liquor potassæ,	½ drachm (2.);
Distilled water,	4 drachms (16.).

Allow the mixture to stand several hours before using. A single drop applied to the cornea with a pipette will stain the ulcer a deep yellow without affecting the surrounding tissues.

*Simple ulcer* is usually small, single, and of a grayish-white appearance, and may be accompanied by considerable photophobia, lachrymation, and pain.

*Spreading ulcer* is a much more serious disease, although its beginning may be the same. Especially when the supply of pyogenic bacteria, from a purulent ophthalmia or dacryo-cystitis, is large and vigorous, widespread and rapid destruction of the cornea may result. It is hardly necessary to say that this fact should always be borne in mind when treating the corneal lesion. In all varieties of ulceration of the cornea irrigation of the conjunctival sac is of paramount importance, whether this remedy be employed before or after direct applications to the ulcer itself, or whether it be used solely as a curative measure. In the simple variety Joenicke's boro-borax is very effective. This is made by dissolving equal parts of boric acid and borax in water, boiling, and allowing the product to crystallize. A warm 10 per cent. solution may be used for irrigation. Under the name of *antipyonin*, disodic dodecaborate, a similar compound, has been recommended, in the same dose and to be used in the same manner, by Rolland. Antipyonin is also used, instead of boric acid, as an application, in the form of fine powder, to the conjunctiva in the suppuration which often accompanies corneal ulcer.

The application of escharotics, especially the electro-cautery, to spreading ulcer of the cornea is the most valuable means we possess of cutting short its progress. A very effective cautery of the ulcer may be accomplished by means of lactic acid. After thorough cocaine-ization a pointed wooden tooth-pick is dipped into a 30 per cent. solution and carefully and thoroughly applied to the diseased area. A small slough separates in the course of a few days. Galezowski uses, instead of lactic acid for cauterizing the ulcer, a 1 per cent. mixture of gold carbolate. In the same way one may apply to the ulcer, and with the best results, a few crystals of the soziodolate of zinc. This forms a white eschar which does not spread beyond the limits of the diseased surface. The application may be repeated, as the cauterization is not a deep one and leaves a very slight scar, or it may be followed by gentle massage, once a day (Goldzieher), with—

Sodic soziodolate,	8 grains (0.50) ;
Neutral atropine sulphate,	1 grain (0.05) ;
Vaseline,	2 grains (10.).

A few drops of a solution of rotoin or scopolamine should be instilled every three or four hours, when the ulcer is centrally situated and there is pain or other acute symptoms. Where atropine is indicated Jackson advises the following collyrium :

Neutral sulphate of atropine,  
 Cocain muriate,            of each 1 grain (0.05);  
 Distilled water,            2 drachms (8.).  
 One drop of this at a time.

Large disks, made with gelatin and iodoform, to be carefully applied to the cocainized eyeball and followed by an antiseptic bandage, have been recommended, but these are painful and seem to possess little advantage over dusting the surface with finely powdered iodoform. Vacher has employed an eye-wash of a watery solution (1 : 250) of potassic permanganate. Di Vincentiis advises the employment of subconjunctival injections of sodic chloride and mercuric chloride in spreading ulcer complicated with hypopyon (pus in the anterior chamber). In the majority of instances a single injection is all that is necessary, but in the worst cases two or three doses, at intervals of one or two days, may be required. De Wecker has quite lately given very explicit directions for the employment of this remedy. He believes that when properly carried out there is no agent more prompt in effecting a cure of all forms of corneal ulcer. The eyelashes are first disinfected with a 1 : 100 solution of mercuric oxy-cyanide, and the conjunctival sac is then thoroughly irrigated with a 4 per cent. solution of boric acid. Fifteen drops of the following solution are now injected beneath the conjunctiva as near the ulcer as possible :

Mercuric chloride,             $\frac{1}{4}$  grain (0.015);  
 Eserine salicylate,           1 " (0.05);  
 Distilled water,            3 $\frac{1}{2}$  ounces (100.).

This should be repeated daily, if necessary, but the dose should be diminished as soon as improvement is noticed. Each injection should be followed by an antiseptic bandage. When iritis is present scopolamine should be substituted for the eserine.

As most of these subconjunctival medications are painful they have sometimes added to them a small quantity of cocaine. Dolganoff claims that a 1 per cent. solution of paraclorophenol in water forms an analgesic injection that acts quite as quickly as the mercurial salt, and that the pain following it is slight and lasts only a few minutes.

When simple ulcer of the cornea is associated with a chronic conjunctivitis, dacryo-cystitis or blepharitis, massage, once a day, with either a mixture of euophen ( $\frac{1}{2}$  to 1 per cent.) or aristol (1 per cent.), with equal parts of vaseline and lanolin, will be found efficacious.

Where simple ulcer of the cornea does not promptly heal it may be touched with a 1 : 10 solution of iodine trichloride, the sac being subsequently irrigated, twice a day, with 1 : 1000 of the same remedy.



Corneal scars (*nebulae*, *maculae*) are most likely to be reduced in area and thickness by pressure-massage with stimulating ointments. One of the best of these, to be applied once daily for weeks or months, is—

Yellow oxide of mercury,	1½ grains (0.10);
Iodol in fine powder,	7½ “ (0.50);
Vaseline,	
Lanolin,	of each 75 “ (5.).

Foreign bodies imbedded in the cornea may be removed under local anesthesia produced by a 1 per cent. solution of holocain instilled in precisely the same way as and instead of solutions of cocain or eucain. The first drug possesses the distinct advantage of not dilating the pupil, nor does it cause dryness (and ready removal) of the corneal epithelium. A transient and sufficient local anesthetic for the same purpose is made as follows:

Desiccated powder of	
suprarenal capsule,	3 grains (0.20);
Sterile warm water,	1½ drachm (5.).

Stir briskly (with a clean toothpick) in a spoon or salt-cellar for five minutes. Allow the undissolved portion to settle for another five minutes, using only the supernatant liquor. Two drops dropped into the eye every minute for three minutes will produce blanching of the conjunctivæ and sclera (and anesthesia) in five or six minutes. The mixture will undergo decomposition in a few hours and should be freshly prepared for each occasion. Another new local anesthetic is *nirvanin*, commonly used as a 2 per cent. solution.

**Scleritis and Episcleritis.**—Inflammatory patches characteristic of both these affections have been successfully treated by the application of the galvano-cautery. Internal treatment is almost always called for, and search should be made for the presence of any of the well-known causes of these diseases. Absorption of the scleritic plaques is certainly helped by massage with an ointment composed of sodic iodide 0.25 gramme and vaseline 10 grammes. If the deeper structures of the sclera be affected, Puech has advised the painting of both lids every morning for five days with the ordinary tincture of iodine. Finally, subconjunctival injections, as described under Iritis, are found to act well in most instances.

**Herpes of the Cornea.**—*Herpes zoster ophthalmicus* is usually a part of a neuritis affecting the minute nerve-endings in and about the conjunctivæ and lids and it should be treated in connection with the

other manifestations of the disease. The corneal vesicles are serious lesions, owing to the resulting scars and the possible visual defect that so often remain when the eruption occupies the pupillary area. Bourgeois advises that the eye be carefully irrigated with warm boric acid lotion and the cornea afterward dusted with the following powder :

Bismuth subnitrate,	
Powdered starch,	of each 62 grains (4.);
Aristol or iodol,	$7\frac{3}{4}$ " (0.5).

In addition, the eye should be protected and pain relieved by morphine or antipyrin. When there is iritis dry heat and a collyrium of  $\frac{1}{4}$  per cent. solution of scopolamine are also indicated.

To the vesicles on the lids may be applied this salve :

Zinc ointment,	6 drachms (22.50);
Boro-glyceride,	2 drachms (7.50);
Carbolic acid,	26 grains (1.75).

Or, when the pain is very severe, this :

Cocaine muriate,	$7\frac{1}{2}$ grains (0.50);
Iodoform,	1 drachm (4.);
Vaseline,	$7\frac{1}{2}$ drachms (100.).

The pain of herpes is also greatly mitigated by the local application to the vesicles or dried scabs of finely powdered euphorin (phenyl urethan).

## IRITIS.

INFLAMMATION of the iris is one of the commonest and most important ocular diseases with which the practitioner has to contend. In the great majority of instances it is symptomatic of some general disorder or accompanies some other disease of the eye. It is well to remember that it may be a local expression of syphilis, rheumatism, gonorrhœa, tuberculosis, gout, scrofula, or diabetes. These general diseases should always receive attention as a part of the treatment of iritis because the duration and severity of the ocular affection may be considerably lessened thereby.

The pupil should be dilated as early in the disease as possible, and

although atropine, duboisine, hyoscyamine, and hyoscine must continue to be the most valuable agents in the accomplishment of this result, we have recently added a number of other valuable mydriatics to the list.

An excellent and effective substitute for the ordinary 1 per cent. solution of atropine, usually ordered in cases of iritis, is the following:

Neutral sulphate of duboisine,	
Neutral sulphate of atropine,	of each $\frac{1}{2}$ grain (0.03);
Cocaine chlorhydrate,	35 grains (2.);
Distilled water,	7 ounces (190.).

Instillation of a single drop of a  $\frac{1}{2}$  per cent. of scopolamine hydrochlorate forms an effective substitute for atropine preparations. All of these cycloplegics may give rise to general toxic symptoms if care be not employed in the use of their watery solutions. When possible these should be instilled after meals. Only one drop at a time should be dropped into the conjunctival sac, and the excess of fluid should be carefully wiped, from the inner canthus outward, off the closed lid-edges.

The treatment by means of subconjunctival injections of corrosive sublimate may be carried out in accordance with the directions of Abadie, *i.e.* four or five doses of  $\frac{1}{10}$  of a milligramme ( $\frac{1}{12500}$  of a grain) each, at intervals of three days. It has recently been observed that from 5 to 10 drops of a sterile 2 per cent. solution of common salt, injected with a perfectly clean hypodermic syringe, answer all the purposes of the bichloride and are not as painful. Even in syphilitic cases mercurial salts appear to possess no curative advantage over the sodic chloride solution. Indeed, it is now claimed that all subconjunctival injections act chiefly by stimulating the lymphatic circulation and thus hastening the absorption of inflammatory products. The pain following this form of medication is not invariably prevented by the use of cocaine. Instead of presenting such anti-rheumatic remedies as the salicylates in *rheumatic* iritis Crinon advises the tincture of gelsemium in full doses daily. In *gonorrhæal* iritis Fuchs advises 15-drop doses, once a day, of the oil of gaultheria, which is best given in capsules.

The internal treatment of *serous* iritis is considered of importance by Galezowski. He advises that the urate of piperazine be given in  $\frac{1}{2}$ -gramme doses once or twice a day.

The treatment of the *tubercular* form of iritis is not very satisfactory. The exhibition of creasote (dose 0.05 gramme) in pill form, six times daily, increasing the dose until fifteen pills are taken in twenty-four hours, is recommended by Quint. This treatment should be con-



tinued for months. Another remedy is ichthyol. Four drops of a mixture composed of equal parts of this drug and water should be administered three times daily before eating. The dose should be increased one drop daily until forty drops are taken at one dose. To avoid gastro-intestinal irritation the ichthyol should be administered in a large quantity of water. Iodoform, triturated with one-half its weight of powdered coffee, may also be administered in cachets.

It is sometimes difficult to make a differential diagnosis between the tubercular and other forms of iritis. In such cases tuberculin injections may be used. Indeed, Leber has reported a complete cure of tubercle of the iris after ten injections (5 to 10 milligrammes each) of Koch's lymph.

### GLAUCOMA.

RICHEY and others regard this disease as essentially one affecting the general nutrition. In any case it must not be forgotten that the danger of subsequent attacks may be lessened by general constitutional treatment, by dieting, regular bathing, proper exercise, and keeping the bowels freely open. When signs of gout are present Houde's formula is valuable:

Crystallized colchicine,	1 grain (0.06);
Sugar of milk,	1 drachm (4.);
Gum arabic,	7 grains (0.50);
Simple syrup,	15 " (1.).

Divide into 60 granules and give two, three, or four daily. In the same way, rheumatism or any of its manifestations should be carefully treated. But whatever be the predisposing cause of this formidable disease of the eye, it is directly dependent upon a disturbance of the intraocular lymphatic system. The internal lymph-stream arises from the blood-vessels of the uveal tract, flows from the posterior chamber through the pupil, and empties into the canal of Schlemm at the angle formed by the iris and the sclera. It is easy to understand how any obstruction of this stream of lymph or any abnormal increase of the lymphatic fluid may bring about an intraocular tension dangerous to vision. The eyeball grows harder and the delicate parts within the eye immediately suffer. It is of the utmost importance that this destructive disease should be early recognized, and should not be mistaken, as it often is, for supraorbital neuralgia *plus* conjunctivitis or iritis (see table on p. 807). When such an error is

made, atropine or some other mydriatic is likely to be prescribed and a bad matter thus made worse.

Although the most satisfactory measure is a broad, peripheral iridectomy or a posterior sclerotomy, relief sometimes follows certain local applications. In *acute glaucoma* Faber advises the use of pilocarpine nitrate, 0.05 gramme to 10 grammes of distilled water; this is to be dropped into the eye every three or four hours, as long as the intraocular tension is increased. The artificial leech and the internal administration of morphine are recommended for the relief of pain. In the *chronic* form a 25 per cent. solution of antipyrin may be injected, with Anel's lachrymal syringe, into the nasal duct of the affected eye. This procedure not only relieves the pain of the disease but is recommended as a curative measure. Gentle massage of the globe—rubbing the upper lid over the eyeball—after instilling warm vaselin, castor oil, or lanolin into the conjunctival sac, has recently been tried with success. The application should be made daily at first, and each sitting should occupy five minutes.

### TOXIC AMBLYOPIA.

A GREAT many poisons exert a deleterious action upon the eyesight, but the most important and most common of these are tobacco and alcohol. They set up a chronic and painless inflammation of the optic nerve, which, however, readily yields to treatment.

There should be total and immediate abstinence from the use of tobacco and alcohol in any of its forms, and the patient should observe every other hygienic rule. When there is no contraindication a Turkish bath twice a week is a valuable remedy. Some such tonic mixture as the following should be prescribed:

Tincture of iron chloride,	4 drachms (16.);
Dilute phosphoric acid,	4 grains (0.25);
Quinine sulphate,	6 drachms (24.);
Strychnine sulphate,	2 grains (0.1);
Tincture of rhubarb,	2 drachms (8.);
Simple syrup,	to make 8 ounces (250.).

A small teaspoonful in a wineglassful of water before each meal.

Hypodermic injections of a 1 per cent. solution of nitrate of strychnine should also be administered three times a week. This solution should be made with distilled water and without alcohol. The initial dose must be small, say five drops, to be increased drop

by drop until toxic symptoms are produced. The dose should then be decreased a few drops until the cure is complete.

### OCULAR AFFECTIONS IN GENERAL DISEASES.

THERE are certain signs and symptoms exhibited by the visual apparatus and complained of by the patient that do not necessarily indicate organic ocular disease at all, or point only to a partial or secondary involvement of the eye. Graves' or Basedow's disease is one of these. In recent years a number of internal remedies have been employed in the treatment of the eye-symptoms. Chibret gives large doses of sodic salicylate,  $\frac{1}{2}$  to  $\frac{4}{5}$  of a gramme, four times during the twenty-four hours, dissolved in a large quantity of water. If the patient cannot take such a large dose the amount is diminished, but it must be given for weeks at a time. He has seen improvement, especially of the tachycardia, in a very few days. The following mixture may be taken every two, three, or four hours, unless intoxication is produced, for several weeks at a time:

Powdered digitalis leaves,	$\frac{1}{8}$ grain (0.02.);
Ipecac,	$\frac{1}{2}$ " (0.035.);
Extract of opium,	$\frac{1}{20}$ " (0.0025.).

Amelioration of the symptoms is noticeable in a few days and in some cases a practical cure has been brought about after several months. Exalgine (methyl-acetanilide), in 3-grain doses three times a day, has also been employed with success. Finally, Bogroff has advised the hypodermic injection of extract of the thyroid gland, beginning with a single drop of the organic extract, and increasing the dose until four cubic centimetres are administered.

### SYMPATHETIC OPHTHALMIA.

IT has been demonstrated to a certainty that germs may be carried from an eye whose coats have been perforated, either by traumatism or from disease, to the opposite eye and there set up a destructive inflammation. The most dangerous wounds, so far as concerns their liability to produce sympathetic ophthalmitis, are those that penetrate the region of the ciliary body. This is an area four or five millimetres in width that extends around and a few millimetres outside of the sclero-corneal junction, called by Nettleship the "dangerous zone." Pieces of steel and other foreign bodies lodged in the interior of the eyeball, as well as perforating ulcers of the cornea, may also light up the dis-



case. The earliest sign of this *migratory ophthalmia* is tenderness on pressure over the ciliary region—the patient flinches when the eye is pressed upon. With this are usually noticed inability to read, slight photophobia, lachrymation, and some redness of the eye. Usually there is no pain. The stealthy setting in of these symptoms on the sound side, after a penetrating wound of the other eye, may well cause anxiety, especially when to the tenderness are added sensible impairment of vision, pain, more lachrymation and photophobia, and a deeper injection of the pericorneal vessels. Plastic deposits now take place in the ciliary body, iris, and cornea. If relief be given the eye may partially or wholly recover, but in any event the course of the disease is always very chronic, very variable, and very wearisome to both patient and surgeon. It sometimes happens that months after an attack of sympathetic inflammation the injured eye is found to possess better vision than its fellow. In consequence of improved treatment better results have, in late years, followed the exhibition of remedies for *ophthalmia migratoria*. In the early stage (of sympathetic irritation) it may sometimes be aborted by the inunction of mercurial ointment and the injection, into the vitreous chamber, of one or two drops of corrosive sublimate solution, 1 : 500. This is to be repeated in eight days. Instead of intraocular injections subconjunctival medication has been employed with success, in the strength of 1 : 1000. Even when sympathetic inflammation has plainly declared itself large subconjunctival injections, combined with the hypodermic use of mercuric iodide or chloride or the inunction treatment, may so modify it that useful vision may be retained in one or the other eye.

#### OCULAR HEADACHE.

MIGRAINE or sick-headache is frequently accompanied by temporary disorders of sight and is occasionally produced by refractive errors and anomalies of the ocular muscles. Before or during an attack of this distressing form of neuralgia a peculiarly shaped cloud, having often a bright-colored margin, appears before one or both eyes. This spreads until the whole field of vision is obscured and lasts but a short time, after which sight is as perfect as before the attack. Attention should be paid to the refractive condition of the eye, and when ametropia (especially astigmatism and hyperopia) is present proper correcting glasses should be prescribed. In addition to this, numerous prescriptions have been lately suggested for the relief of the pain or for the purpose of aborting the attacks. Among the most reliable of these is the following :

Antifebrin,	
Phenacetin,	
Exalgine,	of each 1 grain (0.05.);
Antipyrin,	8 grains (0.50.);
Cocaine muriate,	$\frac{1}{12}$ grain (0.005.).

This powder is to be given, as early as possible in the attack, every half-hour, but not more than four doses in all should be taken.

*The diagnosis of simple ocular headache*, as distinguished from migraine, is of such very great importance to the general surgeon that it must be considered as a prelude to the subject of treatment. As I have said elsewhere, it is manifestly the duty of every practitioner, be he specialist or non-specialist, to instruct himself in the natural history of all forms of headache, whether he aspires to remove the cause in a given case or not. Such knowledge would, for instance, deter the oculist from attempting to treat a malarial headache by cutting the external rectus muscle, the surgeon from dividing the supraorbital nerve for the cure of a unilateral neuralgia due to monocular astigmatism, the physician from persevering with quinine, phenacetin, or antipyrin to effect a cure of that frontal distress which accompanies and is one of the common symptoms of recurrent glaucoma; the rhinologist from making the devious ways of the nasal meatus straight because his lady patient complains of the dull vertical headache of uterine disease, and so on to the end of the chapter. The characteristics of *ocular headache* may be set down as follows:

1. *Forty per cent.* of all headaches and *eighty per cent.* of all frontal headaches are partially or wholly of ocular origin. They are of all varieties, from a "dull sensation" to suffering of the most intense character, and may affect the patient at any time of the day, but they practically never wake him from sleep.
2. Their site, in order of frequency, is supraorbital, deep orbital, intracranial, temporal, supranasal, vertical, and occipital.
3. Near work is their chief exciting cause—*i. e.* reading, writing, drawing, painting, fancy-work, typesetting, typewriting, sewing, music, etc.
4. Patients suffering from ocular headache often observe that other eye-symptoms also result from the use of the eyes for near work—especially with artificial illumination.
5. Shopping, theatre- and church-going, as well as riding in street cars and railway trains, often induce it.
6. The letters and lines in reading and notes in music blur, run together, and get "mixed up."
7. The patient with ocular headache is generally astigmatic or has some refractive error.

8. Patients with ocular headache often complain of lachrymation, photophobia, foreign-body sensation, specks floating before the eyes, itching and burning of lids, redness of eyes, etc.

9. The symptoms of eye-strain above mentioned may be present and the headache be of ocular origin, although the vision is normal and there is no manifest astigmatism. The patient in such a case overcomes his hypermetropia or astigmatism, or both, by continuous muscular effort.

10. About *ten per cent.* of all ocular headaches are incurable.

For the temporary relief of this form of headache there is probably no better local application than the so-called oleate of veratrine, and it is certainly preferable to the internal administration of many vaunted specifics. The formula is—

Veratrine,	150 grains (10.);
Oleic acid,	3½ ounces (100.).

The skin over the painful region is to be first thoroughly rubbed with a dry towel and then massaged with a very small quantity of the ointment. This is a very irritating mixture and care should be observed that none of it is introduced between the lids. The application may be repeated every hour or two, but the possibility of intoxication, due to absorption of the veratrine, should not be forgotten.

A very simple and very effective agent for the *relief* of ocular headache is the application of very hot or very cold fomentations to the ocular region. The patient should take a basinful of ice water (if there be no nasal disease, neuralgia, or other contraindications) and a small towel, folded to make a compress a foot long and three inches wide. The towel soaked in the water should be applied to the closed eyes, forehead, and temples. This should be changed frequently and applied for ten minutes at a time as often as indicated.

#### PARALYSIS, SQUINT, AND OTHER MUSCULAR DISORDERS.

ABNORMAL attitudes of the eyeball are taken in cases of *heterophoria* (muscular insufficiencies), *ocular paralysis*, and *strabismus* or squint.

When affected by either squint or paralysis, both eyes are not directed toward the same quarter in all positions of the globes. One disease may easily be differentiated from the other by the simple expedient of testing the excursion of each eyeball in all directions.



Examined separately they will be found to have a normal excursion in squint while restricted movement in one or more directions can be detected when a muscle (or muscles) is affected by paralysis.

**Paralysis.**—Although it is usual to speak of paralysis of the eye-muscles, yet for clinical reasons it is advisable not to forget their nerve-supply. For, as a matter of fact, it is the nervous function that is disturbed or abolished, and if one recollects the ocular innervation paralytic diseases of the muscles resolve themselves naturally into well-defined clinical groups. It is mainly for purposes of diagnosis—when one wishes to discover what particular muscle is involved—that prominence is given to the loss of muscular function.

There are certain symptoms common to all forms of paralysis. The most important of these is *diplopia*. This occurs in every instance where vision in both eyes is good, and is due to the fact that images of objects do not fall on corresponding parts of both retinæ. It is by the relation of these double images—a somewhat difficult subject for the student—that most authors seek to indicate the particular muscle affected. Vertigo and even nausea—the nervous effects of the diplopia and of false projection—as well as indistinct vision are symptoms frequently complained of. Headache is not uncommon. The patient, to avoid the annoyance of double vision, will usually close one eye or turn his head toward the paralyzed muscle. This sign often indicates which muscle is affected.

Causes of paralysis are chiefly rheumatic or syphilitic affections, either of the nerves themselves in their course from the brain or of their nuclei. Organic deposits in the bony canals along which most of the cerebral nerves run, or exostoses from their walls, as well as growths from the neurilemma, may exert pressure sufficient to bring about a temporary abolition or a total loss of their function. The re-absorption of these growths or deposits may result in a cure unless too great damage has been done to the nervous elements. When one nerve alone is affected the cause is probably a peripheral one, while nuclear paralysis is to be suspected if more than one nerve suffers.

Although syphilis and rheumatism play a very important rôle in the causation of these pareses it is sometimes difficult to demonstrate their presence. A few cases, however, result uniformly from one cause; paralysis of the external rectus, for example, almost invariably occurs in rheumatic subjects. Diphtheria sometimes produces orbital paralysis and is a cause of cycloplegia with dilated pupil (iridoplegia). These paralyzes are present in (usually as an early indication of) locomotor ataxia. Paralysis of the external rectus is not unusual in diabetes.

Diphtheritic paralysis and the *primary* paralysis of tabes almost invariably disappear. So do most of those that depend upon periphe-

ral causes. If of central origin many syphilitic cases get well, but some do not. For obvious reasons the later tabetic pareses persist, as well as many others of central origin.

It is justifiable to cover the affected eye with a shield so as to guard against the troubles of diplopia. Specific treatment will be given when it is indicated, and even when there is no definite history of syphilis potassic iodide, administered in gradually increasing doses until 30 or 40 grains or more are taken three times daily, may be continued for several weeks or months.

In conjunction with the internal administration of potassic iodide (in cases of paralysis suspected to be due to syphilis), de Wecker advocates the hypodermic use of corrosive sublimate, and advises this formula:

Mercuric chloride,	15 grains (1.);
Sodic chloride,	30 " (2.);
Morphia acetate,	6 " (0.40);
Distilled water,	3½ ounces (100.).

A Pravaz syringe-ful contains 0.01 centigramme of sublimate. One-half of this should be injected daily, or every two days, observing strict antiseptic precautions. Ten injections are usually sufficient. De Wecker asserts that this form of medication is valuable even in the non-syphilitic varieties of ocular pareses.

Cupping the temple in the early stages and the employment of the constant current (2–4 milliampères) are remedies of extreme value. Cocainize the eye and place the negative pole (a small sponge) between the lids directly over the paralyzed muscle. The positive pole may be applied to the neck. This can be kept up for three or four minutes at a time and is a better plan than the usual application of a larger sponge to the closed lids.

**Strabismus or Squint.**—This affection is sometimes called "concomitant" squint, because, although the relation of the visual axes is not a normal one, it is a constant relation—one eye moves about when the other does. In "paralytic" squint this is not the case. Much confusion arises from the calling of paralytic diseases "squint," and it would be better to confine that term to the conditions about to be described.

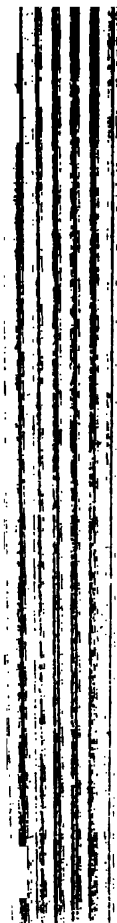
The two most important and by far the commonest varieties of this disease are *convergent* and *divergent* strabismus.

Most squinting eyes manifest themselves if the patient be directed to look first at a near point, say 30 cm., in front of his nose and then at some distant object.

In the early stages of the crossed eyes of children *convergent*

strabismus may be checked by preventing the use of the vision for near work. The kindergarten school should be avoided, and the child encouraged to play out of doors. He should not be taught to read or allowed to play much with toys requiring near vision until the time arrives for glasses or operation. One drop of a weak (1 : 500) solution of scopolamine, rotoin, or atropine (1 : 250) should be dropped into each eye twice a day for two weeks out of every month, as long as swelling of the lids, dry throat, or flushed face is not produced. As long as the pupils are dilated from this use of mydriatics dark glasses should be worn. Later, the patient should be given a *full* correction of all refractive errors. Weak scopolamine or atropine drops are also to be prescribed for a few weeks and glasses worn constantly. In a fair percentage of hypermetropic cases this alone will bring about a complete cure in the course of several months or a year. If, after such a trial, little or no improvement results, an operation is indicated.





## DISEASES OF THE EAR AND THEIR TREATMENT BY THE GENERAL PRACTITIONER.

By S. MacCUEEN SMITH, M. D.

### GENERAL CONSIDERATIONS.

As the title of this chapter indicates, the following pages will be devoted to a brief consideration of the more common diseases of the ear, the treatment of which should become quite as requisite a part of the practice of every physician as the more prominent branches of general medicine and surgery. The fact that the medical profession has not duly appreciated this responsibility, so justly imposed upon it, enables us to account for the present multitude of aural diseases, so many of which tend to become incurable and eventually act as a daily menace to life itself. When we remember that the great majority of ear-diseases will yield to prompt and efficient measures for relief, if instituted in the acute stages of the attack, it would seem almost unpardonable to permit the existence of so many chronic aural affections.

Speaking generally, serious complications result chiefly from the chronic form of aural disease. The inclination, therefore, has been to feel secure, at least as regards danger to life, when an acute disturbance is under treatment. The experience of the writer, however, has been quite contrary to this usually accepted rule; in fact, within a period of eleven months he has seen twenty-seven cases of mastoid disease,<sup>1</sup> each one of which was directly traceable to an acute inflammation of the tympanic cavity. In some of these cases the mastoid empyema was clearly due to meddling interference, while in others no treatment whatever had been established. We frequently find that physicians make no attempt to treat acute conditions of the ear, either from an entire lack of interest or because they have been taught that the treatment of aural disease was quite difficult, and often attended with considerable danger. This incorrect impression has undoubtedly hindered the general practitioner from acquiring methods of recognizing and relieving the many acute diseases of the ear, and prevented this very important branch of medicine from becoming the benefit to

<sup>1</sup> Many of these cases were treated in the Otological Clinic of the Jefferson College Hospital.

suffering humanity that it is otherwise capable of being. As acute diseases of the ear are usually seen first by the general physician, the future welfare of the patient makes it imperative that the gravity of the affection should be immediately recognized and prompt measures for relief instituted, in order to prevent the disease from passing into a chronic state, accompanied, as so frequently happens, by most serious results.

**ETIOLOGICAL FACTORS.**—The great majority of ear-diseases occur in infancy and early life, and especially during the prevalence of the exanthematous fevers. It is of the greatest importance, therefore, that the ears should be given especial care during these attacks, as the tympanic infection is liable to at once become severely purulent, and thus cause rapid destruction of the soft parts. It should be remembered that, with one or two exceptions, a strictly primary disease of the tympanic cavity or labyrinth never occurs. The etiology, therefore, should be carefully considered before treatment is instituted, or failure to improve many cases must be a natural consequence.

Next to the eruptive fevers, the most frequent cause of aural disease is an extension of some pathological lesion from the naso-pharynx through the Eustachian tube into the cavity of the middle ear. The nose and throat, therefore, frequently present etiological factors other than those of the infectious fevers which must not escape observation and correction. In brief, it is safe to assume that most aural affections are secondary to some other existing trouble, the correction of which is as important an element in the line of treatment as the relief of the ear-disease itself; and experience has shown that the failure to recognize this simple fact has been the chief cause of much inefficient treatment.

We may here call particular attention to the influence that epidemics of infectious influenza (*la grippe*) have exerted as a causative factor in the development of severe aural disease. The specific poison (bacillus of Pfeiffer) seems to have a special predilection for causing an active infection (by continuity) of the middle ear, and subsequent or even simultaneous implication of the mastoid. These complications have been quite common during the recent epidemics, and were characterized by the inflammation being very severe, with increased suffering and a manifest tendency for repair to take place slowly, although ultimate recovery was the rule.

**ANATOMICAL RELATIONS.**—The brevity of this article will make it necessary for the writer to assume that the reader is sufficiently familiar with the anatomy of the ear, and the methods of examination of the same, to enable him to effectively apply the various therapeutic measures suggested for the relief of pathologic conditions. It should be remembered, however, that the same integument that envelops the



auricle extends into and acts as a covering for the external auditory canal, and finally, being considerably modified, forms the outer layer of the *membrana tympani*; and also that the mucous membrane of the throat and naso-pharynx extends up through the Eustachian tube, forms the lining of the tympanic cavity, covers the ossicles, extends into the mastoid process, and comprises the inner layer of the *membrana tympani*. By bearing in mind these anatomical facts one can readily appreciate the facility with which disease may be conveyed by continuity into the middle ear and mastoid. Furthermore, it will serve to make us more cautious when making applications or treating this organ, so as to avoid stirring up any inflammation by rough treatment.

In order to understand why so many fatal complications arise from a disease of the tympanic cavity, it is only necessary for us to recollect that the walls of the tympanum are always thin, and in some cases the roof is entirely absent; and also that a portion of each of the temporo-sphenoidal lobes and the lateral lobe of the cerebellum are in direct contact with the middle ear. We should also remember that the carotid canal (through which passes the carotid artery) forms the anterior wall of the tympanic cavity, and the jugular fossa (in which lies the bulb of the jugular vein) constitutes the floor of the tympanum. This explains how a dangerous and even fatal hæmorrhage may occur as the result of caries and necrosis caused by a destructive suppurative disturbance of the middle ear.

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#### DISEASES AND INJURIES OF THE AURICLE.

NOTWITHSTANDING the exposed position of the auricle, diseases due to traumatism are comparatively infrequent, this immunity being due to the elasticity of its framework. With one exception (*othæmatoma*), affections of the auricle, such as scalds, burns, frost-bites, cysts, warts, tumors, malignant or benign, occur as in other parts of the body. Their treatment, being the same as that adopted in other localities, need not be further considered here.

**Othæmatoma, or Blood-tumor of the Auricle.**—This peculiar sanguineous tumor may appear on any part of the anterior surface of the auricle, and is either idiopathic or traumatic in origin. In the former variety it is mostly seen in persons affected with cerebral disease, although it is probable that many cases supposed to be spontaneous are in fact due to traumatism, either self-inflicted or the result of violence on the part of an attendant. Whatever the etiology of this tumor, it appears as a swelling, which at times fills up the entire con-

cavity of the auricle, and causes considerable bulging outward. This swelling is due to the effusion of blood or serum between the perichondrium and cartilage, thus separating the one from the other. Should this fluid be allowed to remain thus confined, it will either gradually become absorbed or go on to suppuration.

TREATMENT.—Traumatic cases receive most benefit from cold applications, especially during the acute inflammation. Applications of the tincture of iodine, gentle pressure, and massage of the tumefaction are advocated by various authors. Should the case be seen early, while the contents are fluid, the best results are obtained by free incision and thorough evacuation of the tumor, followed by packing with iodoform gauze, and moderate pressure, to prevent deformity as much as possible. This same treatment should also be carried out in cases of suppuration.

Generally, it is well to first try expectant treatment, but, if this fails, evacuation of the tumor under the usual antiseptic precautions will give the best general results, although some deformity usually occurs. When possible, the line of incision should be so directed that the subsequent cicatrix may be somewhat hidden beneath the margin of the helix. The gauze packing must be renewed for several days, or until the cavity of the wound assumes a healthy appearance, when sutures can be used to coaptate the edges, the pressure being continued until repair is complete. When this has been accomplished, massage will prove of service in preventing a recurrence of the disease.

## OBSTRUCTIONS AND DISEASES OF THE EXTERNAL AUDITORY CANAL.

### IMPACTED CERUMEN.

THE accumulation of what is usually known as "wax in the ear" is very common, its composition being either cerumen, desquamated epithelium, inspissated pus, or hairs, or several of these intermingled.

As a rule, patients are not conscious of the accumulation until they suddenly experience more or less impairment of hearing. So long as the mass does not completely fill the canal it does not usually interfere with the hearing. The ceruminous glands are mostly confined to the cartilaginous portion of the canal; the collected wax, therefore, will generally be found just beyond the meatus, in which position its removal will be accomplished without difficulty. At times, however, the accumulation is located in the osseous portion of the canal, and may impinge upon the membrana tympani, producing marked deafness. Its removal from this locality without injury to the canal or drumhead requires considerable care, and espe-



cial caution will be necessary where extreme narrowing of the canal is present. When a collection of wax is found in the deep meatus, it is probable that it was pushed into that position either by an attempt at its removal or by some meddlesome efforts to cleanse the ears. The sudden deafness sometimes produced by impaction is caused either by the mass becoming moist, allowing it to completely fill the canal by swelling, and so exclude all sounds, or, in an effort to remove the wax, the plug is forced against the membrana tympani, suspending the function of the conducting apparatus, or a small fragment becomes detached and falls against the drumhead, causing tinnitus and deafness.

TREATMENT.—The removal of this obstruction can be accomplished either by the syringe or by various instruments. Those not familiar with the use of instruments in the ear will find the syringe safer and more satisfactory. Fluids should always be *warmed* before being used in the ear. Should the mass be soft it can easily be dislodged by syringing with warm water in which some bicarbonate of sodium has previously been dissolved. Undue force should never be used. When the mass is hard and difficult to dislodge, or syringing produces pain, further efforts for its removal should be discontinued. The patient is then instructed to use some drops (warmed) in the ear (sodium bicarbonate grains 15, glycerin and water, of each half an ounce) for one or two days, to soften the wax, when the obstruction can easily be removed by renewed syringing. Any accumulation that is not removed by this procedure will require the use of a small hook-shaped instrument (Fig. 299) for its entire extraction, or to loosen it sufficiently so that additional syringing will wash it out.

The best syringe is one with a thin, straight nozzle, holding about four ounces. After directing the patient, or an assistant, to hold a concave ear-basin to catch the return water, the canal is straightened by drawing the auricle outward and backward, the syringe being first filled with water. The nozzle should never be introduced farther than just within the external meatus. In this position the solution is slowly forced from the syringe with a rotary motion, the object being to direct the water so that it will pass between the wall of the canal and the obstruction, and not in the direct central axis; in this manner we permit a free return of the water, and do not at any time throw the stream of fluid directly against the membrana tympani—a matter of much importance in many cases. When the return water is quite clear, all the wax, as a rule, will have been removed. The canal should now be dried with absorbent cotton, followed by the application of ung. hydrarg. ox. flav., and a small piece of sterilized cotton should be kept in the meatus for a day or two, to guard against atmospheric changes. In uncomplicated cases normal hearing is usually restored.



While on this subject it is well to enter a serious protest against the popular habit, so uniformly adopted, of dropping oily solutions and other equally objectionable substances into the ear for the relief of pain, etc. These so-called domestic remedies can have no function except their manifest tendency to act as fungus-generating fluids, and thus frequently transform a simple disease into one of serious moment. If a patient suffers pain or other inconvenience from the ear, the case requires intelligent care, and not the adoption of the "hit or miss" methods above alluded to.

#### FOREIGN BODIES IN THE EAR.

It is usual to divide foreign bodies in the ear into animate and inanimate. The animate class comprises every variety of vermin (usually due to personal filth) and insects. Maggots are sometimes found adhering to the drum-membrane, and generally cause considerable pain, tinnitus, and vertigo. The removal of animate objects can usually be accomplished by using the syringe in the manner already described. At times they will adhere tightly to the lining of the canal or membrana tympani, when it is best that they should first be killed by chloroform vapor, or the instillation of equal parts of tincture of opium and tincture of belladonna, before syringing. The opium and belladonna solution will promptly destroy all animate objects and at the same time exert an anodyne effect which relieves the suffering.

Inanimate objects may be separated into two classes: those that are capable, through heat and moisture, of swelling and becoming so enlarged as to completely fill the canal and act as a source of serious irritation, such as beans, coffee-berries, corn, peas, etc. The other class includes objects not materially influenced by heat and moisture, such as cotton-wool, small pieces of slate-pencil, wood and stone, beads, shells, cherry-stones, shoe-buttons, etc. Cases are not infrequent where foreign bodies have remained in the ears for a number of years without producing symptoms of any note. These substances, however, when influenced by heat and moisture usually make themselves felt within a short period; the swelling first causes deafness, and later, as the tension increases, more or less pain. It must be remembered, however, that the serious damage that frequently follows a foreign body in the ear is not so often due to direct irritation from the presence of this foreign matter as it is to the result of *unskilful attempts at its removal*.

With a good light, a head-mirror, and a speculum of proper size, there should be no difficulty in discovering the presence of a foreign body in the ear. Should the object be deep in the canal, and the anterior meatus inflamed and swollen, some trouble may be experienced until the inflammation has been reduced.

**TREATMENT.**—The removal of foreign bodies from the meatus will at times severely tax the ingenuity of the most skilful operator. Usually the first thought is to employ instruments of various kinds, and it is the yielding to this temptation that frequently converts a condition of little importance into one of considerable magnitude. Let it be remembered that instrumentation, as a rule, inflicts more or less damage to some part of the conducting apparatus; that the employment of instruments for the removal of extraneous matter from the ear is but rarely indicated, and should only be used under perfect illumination and with extreme care; that the proper use of the syringe and warm water will usually dislodge and expel the majority of all foreign bodies. The cases that present difficulties for their removal are those liable to changes from heat and moisture, such as corn, peas, etc., especially when located deep within the canal and beyond the constriction formed by the junction of the cartilaginous with the osseous canal. The expansion of the tympanic end of the meatus will allow an object of this character to swell so much that its removal as a whole becomes quite impossible. If, therefore, after repeated syringing with hot water or sweet oil (in the manner already described), the obstruction cannot be removed, and you are satisfied that instrumentation is necessary, it is best that the patient be anaesthetized. It is well, however, as soon as general relaxation from the anaesthetic has been accomplished, to again resort to syringing (holding the affected ear downward, resting over the edge of the operating-table) before instruments are used.

Should this final effort with the syringe prove unsuccessful, nothing remains but to employ one or more of the several instruments devised for such purposes. In our experience a very delicate sharp-pointed hook (Fig. 299) will give the best results. The hook is intro-

FIG. 299.



duced flatwise, resting against the canal. As soon as it passes beyond the obstruction the point is rotated in such a manner that with slight traction it will draw the object out, or at least loosen it sufficiently to allow renewed syringing to accomplish the purpose. Other instruments, such as forceps, probes, etc., may also be used, but as the hook above referred to occupies a minimum of space (an essential point), it has in most cases answered our purpose best. Should the foreign body have been forced into the tympanic cavity, it may be necessary to separate the auricle posteriorly, in order to gain direct access to the osseous meatus. If this does not prove effective, the posterior

wall of the canal must be chiselled away until the middle-ear cavity is reached. Such a severe injury to the canal or middle ear may result in fatal cerebral abscess, meningitis, etc., but if this is avoided the prognosis is always favorable as regards serious consequences, although much damage to the hearing from careless manipulation is of common occurrence.

#### DISEASES OF THE CANAL.

Inflammation of the meatus should be considered under two heads, circumscribed and diffuse.

Circumscribed otitis externa, known also as *boil* or *furuncle* of the external auditory canal, as its name indicates is a disease restricted to a definite area. Several distinct boils may, however, occur simultaneously in various parts of the canal, or a succession of furuncles may follow each other; quite a "crop" has been seen in one ear. They are very common and may appear in any part of the canal, but are generally found in the cartilaginous portion. In origin they are either traumatic or specific, the latter class frequently occurring as epidemics. Traumatic cases often result from the irritation caused by the introduction of various chemicals and instruments into the meatus. It has long been a question in the mind of the writer whether all cases of furuncle of the external meatus were not due to micro-organisms. The staphylococcus pyogenes aureus is almost invariably found in the pus of boils of the meatus, and certainly, if this infectious germ can find its way through the skin in so-called "idiopathic" cases, it would seem less difficult to infect a surface already rendered pregnable by an injury. However this thought may be received it is generally conceded that furuncles can be artificially produced by rubbing sound skin with staphylococci; furthermore, boils of this character yield most promptly to the application of powerful germicides.

Predisposing factors in the development of furunculosis are of importance, and will include any disease or condition debilitating the general health, such as diabetes, anæmia, etc. Catarrhal conditions of the throat and nose are noticeably present in those suffering from boils of the meatus; while decay of the teeth, or other dental irritations, should be looked for. To be brief, any disease that diminishes the power of resistance in the tissues of the meatus will eventually convert the parts into a productive field for the rapid development of micro-organisms. If, in this "run-down" condition, one should receive an injury of the canal, and then be subjected to the influence of staphylococci, it can readily be seen why a supposed traumatic case may in reality be one of infection, developed from a specific poison, the injury simply acting as a predisposing cause.

It is an easy matter to overlook small incipient boils. Usually,



however, the introduction of a speculum will cause sufficient local pain to indicate the point of development. In more advanced cases the furuncle is readily seen, but may be mistaken for an exostosis, the differentiation being that the former is exceedingly painful to the pressure of a probe, and that there is a marked tendency to become multiple. The pain from furunculosis is generally severe, especially when the boil is located in the osseous portion of the meatus, where the skin of the canal (acting also as the periosteum) is unusually dense, and resists the tension caused by the formation of pus. For clinical purposes a furuncle in this location is identical with felon of the finger, but is, however, subject to greater necrotic danger. Should a boil develop on the superior part of the osseous canal, and the pus not be evacuated, either by rupture or incision, caries may follow, and this in turn result in fatal meningitis or brain-abscess.

**TREATMENT.**—Many lines of treatment, both local and general, have been suggested for the relief of this painful affection; but unless such therapeutic measures have for their object the destruction of disease-germs, they must in a measure be unreliable and disappointing. It must be remembered that the pus from boils is highly infectious; auto-inoculation, therefore, will be frequently encountered unless careful antiseptic precautions are strictly observed, so that the bacteria-laden pus will not reach other parts of the canal. The important object of treatment is the immediate relief of suffering, together with the limitation, modification, or abortion of the inflammatory process. Our ability to accomplish one or more of these purposes will largely depend on the stage the disease has reached before treatment is instituted, as well as the germicidal properties of the remedies employed.

In the majority of cases early incision, followed by an antiseptic dressing, will deplete the parts, thereby relieving the tension and consequent pain. When pus-formation has already occurred, a free incision down to the bone or cartilage is necessary, for the same reason that only a deep incision is of service in a felon: otherwise, continued pain, burrowing of pus, and possibly necrotic changes, may be expected. A majority of incipient boils will be aborted by introducing into the canal a cotton tampon saturated with camphor-phenol;<sup>1</sup> this should be renewed every day or every second day, until all evidence of the furuncle has disappeared. Before a fresh tampon is introduced the canal should be gently mopped out with cotton twisted on an applicator, and saturated with alcohol in full strength. When the boil appears to be eradicated, the camphor-phenol tampon

<sup>1</sup> Camphor-phenol is prepared by mixing 45 per cent. of pure carbolic acid with 55 per cent. of camphor, the mixture forming a liquid of powerful germicidal properties and marked anodyne effects.

should be replaced by one moistened with ointment of the yellow oxide of mercury,

R. Hydrarg. ox. flav.,	gr. ij (0.1);
Ung. petrolei,	℥j (30.).
M. et. ft. ung.	

or iodoform ointment,

R. Iodoformi,	℥ij (12.);
Ung. petrolei,	℥j (30.).
M. et. ft. ung.	

(cleansing each time with alcohol), until the meatus assumes a healthy condition.

When necessary to incise an aural boil, it should be done thoroughly, as suggested above; the after-treatment being the same as in the incipient furuncle, except that the cotton tampon should be slightly larger than the meatus, as the pressure will exert a beneficial influence by favoring rapid absorption and quick recovery. Before a boil is incised the pain incident thereto will be greatly lessened by placing in the canal a camphor-phenol tampon for five or ten minutes. After the pus has been evacuated all suffering will be relieved by immediately introducing a similar tampon. The use of camphor-phenol, when applied for the alleviation or cure of furunculosis of the external auditory canal, is founded on its inhibitory action on the development of the staphylococcus pyogenes aureus, and incidentally on its marked anæsthetic properties. It is, therefore, a powerful germicide and at the same time non-poisonous and non-irritant—an advantage not enjoyed by any other preparation in such concentrated form.

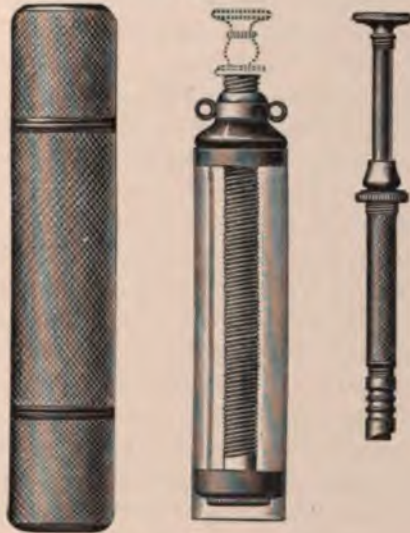
The foregoing line of treatment will meet the requirements of almost all cases of furunculosis of the meatus, and furthermore will prevent auto-inoculation. Other means of treatment are sometimes beneficial, however, and should be used when indicated. In selected cases, bloodletting in front of the tragus, preferably with the artificial leech (Fig. 300), as well as hot antiseptic irrigation, and dry heat, will be of service. Poultices should never be used; the heat and moisture caused by their employment creates an active hotbed for the rapid multiplication of bacteria, and frequently excites an inflammation of the auricle. Moreover, their use is apt to involve the middle ear in an acute inflammation. Any dental irritation, or abnormal condition of the nose and throat should be corrected. In debilitated subjects the general health should receive due consideration. The administration of selected tonics and alteratives, in connection with proper

hygienic surroundings, will do much to assist in the cure of an existing boil, and especially to prevent its recurrence. We would strongly urge the use of arsenic in the form of Fowler's solution, given in increasing doses until the physiological effects are produced; a course of this drug to be repeated several times if necessary.

**Otitis Externa Diffusa.**—In contradistinction to circumscribed otitis externa, the diffused form of inflammation is one that may involve the entire canal, but is usually confined to the osseous portion.

It is claimed that this disease is frequently idiopathic in origin, but we believe it is always due to some direct or traceable cause, keeping

FIG. 300.



in mind parasitic infection. Diffused inflammation of the canal is most frequently associated with a chronic suppurative otitis media, notwithstanding the fact that the discharge may be very slight. It is evident, then, that tympanic suppuration is the most important causative factor in its development; the perforation of the membrana tympani may be very small, and therefore easily overlooked, but careful observation, together with inflation, will prevent our falling into this error. Next in frequency are mechanical, chemical, or thermal irritants, such as the unskilful use of instruments, the presence of foreign bodies, the application of concentrated chemicals, or the introduction into the ear of solutions either too hot or too cold. Certain constitutional disturbances, such as diphtheria, syphilis, scrofula, etc., as well as chronic furunculosis, should receive due consideration.

The important symptom is pain, increasing in severity as the cellular tissue, and subsequently the periosteum and bone, become



involved. Implication of the osseous structure occurs only in neglected and chronic cases. The presence of granulation-tissue indicates bone-necrosis, and should receive particular attention, especially if the roof of the meatus is the part involved, as the inflammation may extend inward and cause meningitis. Considerable swelling of the meatus will be noticed, being more pronounced when the osseous portion is the seat of the lesion. Deafness and tinnitus are prominent symptoms, varying in degree according to the amount of swelling and suppuration, and consequent interference with the function of the membrana tympani. When primarily the middle ear is not the cause of an otitis externa, it may become involved in the inflammatory process by continuity of structure. As previously stated, the presence of *discharge*—always associated with middle-ear suppuration—is an etiological symptom of the greatest importance. Otitis externa diffusa diphtheritica, and syphilitica, have constitutional symptoms and local appearances characteristic of each, making their recognition not difficult.

The gravity and prognosis of individual cases will depend largely upon the etiology, as well as the portion of the canal affected; also whether the inflammation is superficial, or extends to and involves the osseous structure; and lastly, whether middle-ear suppuration is present, in which event considerable swelling of the canal may interfere with the free escape of pus. In all forms of otitis externa, with involvement of the deeper structures, a more or less *chronic dermatitis* may remain after cessation of the acute symptoms.

TREATMENT.—The term otitis externa diffusa may include all inflammations and irritations of the external auditory canal, except that known as circumscribed (furunculosis). This wide range of inflammatory conditions, therefore, may include either a simple erythema or a severely active inflammation which may implicate the bony structures; or, as in syphilis, diphtheria, etc., may prove to be infectious. Obviously, constitutional treatment is of the greatest importance in some cases, while in others simple local applications will suffice. It is well to regard each individual case as possessing, to some extent, characteristics of its own; hence we should aim to discover the cause, and direct active treatment for its prompt removal (not forgetting the general health), and recovery will follow in most cases.

While the inflammation is acute, bloodletting in front of the tragus together with hot antiseptic irrigation of the meatus will be of service. A good antiseptic solution for irrigating the ear is the following:

R. Glycerini, f 3j (30.);  
 Liq. acid. carbolic. (pure), f 3iij (90.).—M.  
 Sig. Add one-half to one teaspoonful to a half pint of water  
 and irrigate as the case may require.

The fountain syringe is much safer and better than the hand syringe generally used. Instillations of warm alcohol, black-wash, or lead-water and morphine will, on account of their anodyne effect, be of service :

R<sub>y</sub>. Liq. plumbi,  
       Liq. morphiæ,                   āā. f ʒiv (16.);  
       Aquæ,                           f ʒx (300).—M.

Sig. Add a tablespoonful to a wineglassful of water, and syringe the ear several times daily.

The bowels should be freely opened by small doses of soda and calomel, repeated p. r. n. In mild cases the inflammation will readily subside by first mopping the canal with alcohol, and then applying either ung. hydrarg. ox. flav. or ung. iodoformi, as previously referred to. This should be repeated every second or third day. When the discharge (not due to middle-ear suppuration) persists, nitrate of silver solution (gr. xl to f ʒj) applied to the surface is indicated.

Should these measures fail, the walls of the canal must be freely incised in the most dependent point or points. Bleeding should be encouraged, as depletion will give prompt relief, and recovery in most cases is greatly facilitated thereby. After incision the canal can be cared for by application of the ointments above mentioned. Early incision is to be preferred rather than too long expectant treatment, thereby preventing osseous involvement, necrosis, tympanic suppuration, etc. Constitutional treatment must be carefully considered, and therapeutic measures administered for the general benefit of individual cases.

**Otomycosis.**—This variety of inflammation is due to the presence and rapid multiplication of microscopic fungi in the external canal. The most common form of vegetable growth met with is some variety of the *Aspergillus* (either *fumigatus*, *niger*, or *flavus*). The patient complains of more or less impairment of hearing, and tinnitus; an almost intolerable itching makes the sufferer quite miserable; efforts to relieve this itching by rubbing or picking the ear only add to the progressive discomfort, and may produce an extensive inflammation; some pain is experienced, but usually not severe. An examination with the speculum reveals large quantities of desquamated epithelium. This débris somewhat resembles blotting-paper studded with yellow or black spots, the color depending upon the character of aspergillus present, which, however, can only be definitely determined by microscopic examination. A distinctive diagnostic point in otomycosis is the rapidity with which these masses will recur after removal, sometimes within a few hours.

**TREATMENT.**—The accumulation is best removed by warm anti-

septic irrigation, followed by instillations of absolute alcohol. The patient's head should be rested on a table, and the ear filled with warm alcohol, which should remain for a few minutes. This can be repeated two or three times a day until all fungi have been destroyed, after which a few applications of the yellow oxide or iodoform ointment will quickly restore the canal to its normal condition.

### DISEASES OF THE MIDDLE EAR.

DISEASES of the tympanic cavity have been divided by authors into various forms of acute and chronic inflammation. For all practical purposes it is sufficient to consider diseases of the middle ear under four heads: (1) Acute Non-suppurative Otitis Media; (2) Acute Suppurative Otitis Media; (3) Chronic Suppurative Otitis Media; (4) Chronic Non-suppurative Otitis Media. It is evident, however, that the second form of otitis media is but a continuation of the first, usually made possible only by the neglect or improper treatment of the first variety; likewise the chronic suppurative is only an advanced stage of the acute suppurative, and is also largely the result of neglect or incompetency.

From the foregoing it must be assumed that many cases of both acute and chronic suppurative otitis media are preventable. In support of this assumption we can without hesitation assert that suppurative diseases of the middle ear are the natural outcome (with comparatively few exceptions) of timidity, neglect, or the application of improper treatment to cases of primary inflammation of the tympanum; it is evident, therefore, that if the initial lesion is promptly and judiciously treated, many acute inflammations of the middle ear will be arrested in the stage of hyperemia, and thus avoid even an acute suppuration, which should in turn prevent the establishment of a chronic otorrhea. Special mention is here given to this important fact, for the reason that in this day of advanced preventive medicine it is plainly our duty to carry into daily practice the effective measures now at our command, and thus frequently prevent the development of suppurative inflammations of the tympanic cavity, thereby avoiding many formidable complications arising from diseases of the ear.

#### ACUTE NON-SUPPURATIVE OTITIS MEDIA.

Acute inflammation of the middle ear without suppuration (also known as catarrhal inflammation) is the most frequent cause of "ear-ache" in infancy and childhood; nevertheless, the real cause of the child's crying and fretfulness is frequently overlooked.



An extension (through the Eustachian tube) into the middle ear of some abnormal condition of the throat and naso-pharynx is the most frequent cause of this form of tympanic disease. Children are very susceptible to draughts of air striking the ear, or any exposure to dampness. Sea-bathing, the careless use of solutions in the nostrils, dental irritation from decayed teeth or during dentition, are likewise exciting factors. An acute otitis media from any of the above causes will usually yield to prompt treatment, care being taken to remove the exciting cause. If, however, the middle-ear inflammation develops during the course of one of the infectious fevers (scarlet fever, measles, diphtheria, etc.), the consequent exudation is usually purulent, and does not respond so quickly to therapeutic measures. Deep-seated pain, increased by pressure on the tragus, is usually the first symptom experienced. The suffering may be intermittent, and mild during the day, but the pain increases at night. Children retire in their usual good health, but their slumber, without apparent cause, is disturbed; sharp crying and a tendency to rub the affected ear, with tossing of the head, are prominent symptoms in infants and young children. These objective signs, together with an examination of the membrana tympani, are all the diagnostic data obtainable in such young subjects. Deafness and pulsating tinnitus, more or less marked, depending upon the extent of the hyperæmia and swelling of the mucous covering of the middle-ear cavity and ossicles, together with a sense of fulness, are additional symptoms complained of by those old enough to make such observations. When a child persists in fretful crying, and the cause of its suffering cannot be otherwise explained, an examination of the ears will frequently reveal the true cause of its discomfort. On examination of the membrana tympani vascular injection will be noticed, especially marked along the handle of the malleus; bulging of the membrane may be present, but this is rare in simple catarrhal cases, unless (from neglect) the muco-serous exudate should accumulate in considerable quantity, in which state it will undergo decomposition unless relief is obtained from drainage through the Eustachian tube or by an opening in the membrana tympani. In mild cases the exudation is muco-serous and may give rise to very little suffering; but in the more severe forms it becomes distinctly purulent, associated with great pain, and regularly develops into the acute suppurative form.

TREATMENT.—We again desire to urge the importance of early and active treatment in primary disease of the tympanic cavity, in order to arrest the inflammatory process before it reaches the stage of suppuration. Bloodletting in front of the tragus by means of the artificial leech (see Fig. 300) is of the first importance in arresting the disease at the stage of hyperæmia and assisting in the relief of pain;

one or two cylinders of blood, or its equivalent (two to four Swedish leeches) should be extracted. In young children a blister in front of the tragus will answer a fairly good purpose when bloodletting cannot be resorted to. Hot sedative instillations, repeated as required to relieve pain, may be employed. Equal parts of tincture of opium and tincture of belladonna, warmed and dropped into the ear, or atropine sulph. gr. iij, morph. sulph. gr. xx, to aquæ fʒj, are valuable sedative solutions possessing marked anodyne effects. To avoid possible constitutional effects, proper judgment must be exercised in the use of the morphine and atropine solution. In severe cases applications of heat (dry or moist) will greatly assist in relieving pain; the heat is best applied by gentle antiseptic irrigation of the canal (through the fountain syringe), or the use of the hot-water bag. The applications must be *hot* to be effective. Irrigation is to be used only when dry heat fails to give relief, and even then the greatest care must be exercised not to use force. The naso-pharynx should be carefully examined and measures applied to correct any abnormal condition. Free purgation by the use of divided doses of calomel and sodium bicarbonate should receive early attention. Salol and phenacetin, or antipyrin in sufficient dose, will be of service in appropriate cases. Pilocarpine, by the mouth or hypodermically, may help to abort the disease if administered early.

#### ACUTE SUPPURATIVE OTTIS MEDIA.

As before suggested, this form of tympanic disease is an advanced stage of the non-suppurative variety, or, in other words, the inflammation, not having been arrested and confined to the mucous or catarrhal stage, passes on to the suppurative. The symptoms are similar to the foregoing but are greatly intensified, together with some involvement of the mastoid, which, however, usually subsides with the evacuation of the pus from the middle-ear cavity. The pain is at times most severe and increases in proportion to the distention of the membrana tympani by the progressive accumulation of fluid in the tympanum, until finally the pressure becomes so great that the tension of the drum is overtaxed, and, with a report quite audible to the patient, it ruptures. A copious flow of pus follows, and usually relieves the suffering. By this time, however, great damage has been done both to the membrana tympani and the tympanic cavity. Instead of the opening in the drumhead quickly repairing, as it will do when *incised*, the lacerated edges of the perforation are much slower to mend. The injury done to the delicate mucous lining of the tympanic cavity (due to maceration from pressure) gives rise to a discharge that becomes more or less chronic; whereas, if the accumulation had been promptly evacuated by means of a free incision, the pain would have



been relieved, cessation of the discharge accomplished, and a restoration of hearing produced, all within a few days.

The above is an outline of the average case of acute suppurative otitis media, the treatment of which must be varied, however, in accordance with individual cases, depending chiefly on the etiology. Cases occurring during the course of one of the eruptive fevers or some other severe constitutional disease, such as syphilis, tuberculosis, etc., do not of course respond to treatment so promptly, as improvement of the general health must first be accomplished. It is possible to have an acute otitis media progress to the stage of suppuration with rupture of the membrana tympani without any suffering whatever, the first symptom noticed being the discharge of pus through the external canal. This condition usually occurs in subjects of tuberculosis, which disease should be suspected even in those not previously known to be so affected. On the other hand, the membrana tympani may be so strong as to effectually resist the tension exerted by the progressive accumulation of fluid, and this will tend to find its way into the mastoid or to produce some intracranial complication. Fortunately, however, Nature has wisely provided a drum that will usually rupture of its own accord when the pressure from the accumulated pus reaches the danger-point.

A continuation of pain after the evacuation of fluid from the middle ear would indicate that thorough drainage had not been accomplished, which is accounted for by the opening in the drum-head being too high, or the paracentesis insufficient. Or again, the mastoid may have become involved, or an osteitis of the tympanic walls set up, all of which should receive prompt attention. As the pus or muco-pus accumulates in the tympanum, the drum-membrane undergoes marked changes, and in a corresponding degree the osseous meatus participates in the severe inflammatory process, both becoming extremely red and painful. The membrane loses all its characteristics, the handle of the malleus is no longer seen, and as the tension increases the short process becomes invisible, and finally the drum ruptures, unless other and better means are taken to evacuate the pus. If the opening in the drum-head is now examined, a pulsation, synchronous with the heart's action, will be seen. There will be more or less febrile disturbance present depending upon the severity of the attack.

TREATMENT.—It is to be assumed that if the patient is seen before actual suppuration has taken place, every effort will have been made to arrest or modify the disease without surgical interference. If, however, the case does not yield to the treatment outlined for catarrhal otitis media, and the pain continues, with bulging of the drum-head, the latter should be immediately incised, the point of election usually being the posterior inferior quadrant. However, as



it is possible for the pus to be confined either to the superior or inferior portions of the tympanic cavity, it is best to open the membrana tympani at the most dependent point; always remembering that in any case the object to be accomplished is the free evacuation of fluid from the middle-ear cavity. The drumhead, therefore, should never be punctured, but, on the contrary, a *free incision* should be made, always extending it down to the inferior surface of the canal, so as to ensure good drainage; otherwise the suffering and danger incident to confined pus will continue. Care should be taken that the incision shall not interfere with the ossicles. It seems scarcely necessary to suggest that surgical interference should only be attempted under good illumination and with perfect antiseptic precautions.

The after-treatment in most cases is very simple, and consists in carefully cleansing the ear every day with sterilized cotton twisted around an applicator, after which the canal is gently filled with a strip of iodoform-gauze. In uncomplicated cases the disease should be relieved in twelve days or less, while the hearing will be restored in about the same length of time. Should pain continue after liberation of the pus (mastoid involvement being excluded) it is probably due to the puncture being too small for the purpose of free drainage, or to a considerable maceration of the mucosa caused by the long-continued pressure of the confined pus. In the former case the opening should be enlarged without delay; in the latter, an application of silver nitrate, 5–40 grains to the ounce of water, should be warmed and applied directly within the middle-ear cavity once daily for several days, or until a healthy condition is produced. One application will frequently give prompt relief from further suffering. Hot antiseptic irrigation should not, as a rule, be used in acute suppurative cases; there are, however, some exceptions. Irrigation is especially serviceable in cases with continued severe pain and profuse discharge, particularly when resulting from one of the eruptive fevers, or from diphtheria. In these diseases, however, a much better and more prompt recovery is obtained by early incision of the membrana tympani. Nevertheless, it will be better to allow the drumhead to rupture (serious as this may be), and employ irrigation, rather than to have the possibility of a grave accident from the careless use of the knife, or an injury done to the canal by the introduction of the iodoform-gauze packing. Early inflation of the tympanic cavity was formerly thought to be an important part of the treatment, but this should not be done until improvement is well advanced, and then only for the purpose of preventing adhesions.

As incision of the drumhead is usually very painful, general anaesthesia should be employed when possible. Local anaesthesia has proved to be uniformly unsatisfactory, in our experience.

## CHRONIC SUPPURATIVE OTITIS MEDIA.

Chronic suppuration of the middle ear is merely a continuance of the acute disease just described, caused either by a failure to relieve the acute form, or, as is more frequently the case, by the entire absence of any rational treatment. As before mentioned, tubercular suppuration may be primarily chronic and not pass through the acute stage of pain and other disturbance. Diphtheria, scarlet fever, and other exanthemata, on account of their specific nature and the great impairment to the general health they cause, are the chief factors producing chronic otorrhœa. There is always more or less impairment of hearing, depending upon the location of the perforation, the extent of thickening or swelling of the mucosa, and the amount of clogging of the chain of ossicles.

In uncomplicated cases the character of the discharge is that known as healthy or laudable pus. During repair it becomes thin or watery, progressively decreasing in quantity. When intermixed with blood, it indicates the presence of granulation-tissue. Decay of bone is shown by the pus being brownish in color, associated with excessive fœtor. It must be remembered, however, that non-fœtid pus contains large quantities of pathogenic cocci, in which state it is highly infectious, and as dangerous to life as the fœtid variety. In an ear that has been properly cleansed, excessive fœtor will arise only from bone-necrosis, and should elicit immediate efforts for its relief.

The brevity of this article will not allow a discussion of the location of the various perforations of the membrana tympani and their significance, except in so far as the necessity arises for dividing all cases of chronic otorrhœa into two classes, *i. e.* those in which the perforation is situated in the *inferior* part of the membrana tympani, and those involving the *superior* portion, more especially that part known as Shrapnell's membrane (membrana flaccida). This simple classification is advisable from the fact that the line of treatment differs materially in each. Furthermore, the former is indicative of a condition that is not prone to serious complications and usually yields promptly to treatment of the more ordinary kind, whereas the latter variety is always significant of a much more serious disease. Granulation-tissue (always the product of chronic suppuration), and necrosis of the ossicles or walls of the tympanum and mastoid antrum, must invariably be suspected. It will be seen, therefore, that this latter form of chronic otorrhœa is capable of causing a condition so formidable as to at once become a daily menace to life, and which cannot, as a rule, be permanently relieved except through operative interference. When one remembers the very thin plate of bone that separates the middle ear from the interior of the skull and important blood-vessels, and the direct communication with the mastoid antrum and cells, it



does seem remarkable that many more fatal complications do not occur. The longer the suppuration continues the greater will be the destruction of these delicate walls; and hence the danger to life will be correspondingly increased.

TREATMENT.—We will first consider the treatment of cases in which the perforation is situated in the inferior half of the drumhead, and then take up treatment of cases with the opening in the superior portion. Sometimes the entire membrana tympani is destroyed, the treatment of which condition will come under the second heading. The chief object, in any and all classes of cases, is the use of every available means to relieve or modify a discharging ear, thereby preventing any serious or fatal complications; remembering that the longer the case continues the more imminent the danger becomes. It must not be forgotten, however, that the same formidable implications may occur in the acute disease, but with less frequency. Cleanliness and general antiseptic precautions are so absolutely essential in the successful treatment of all cases, that any deviation from their well-defined principles will generally result in failure. Irrigation with an antiseptic fluid should only be employed in exceptional cases. A better and more thorough way to cleanse the ear is to mop it out with sterilized cotton saturated with hydrogen peroxide until all secretion has been removed, when applications of stimulating or slightly escharotic solutions should be made into the tympanic cavity, as the case may require, depending upon the presence or absence of a tendency to granulations. This should be followed by packing the deep canal with iodoform-gauze, renewed every one, two, or three days, according to the amount of discharge. Repeated cleansing of the ear in this manner (cotton twisted on applicator) with a warm 2 per cent. solution of carbolic acid, hydrogen dioxide, or liq. plumbi subacetatis, followed by the iodoform-gauze packing, will be sufficient to cure most cases of recent date. Those of longer standing may, in addition, require the stimulation of nitrate of silver in various strengths, commencing with 5 grains to the ounce and increasing to 60 grains if necessary. Dusting the surface with acetanilid powder will assist in arresting putrefactive changes, when such an agent is required. An attempt to destroy granulation-tissue can be made with strong solutions of chromic acid or nitrate of silver, or, still better, the application of absolute alcohol. Pain caused by the alcohol will be somewhat reduced by combining with it a 50 per cent. solution of boro-glyceride in the proportion of 1 drachm to the ounce of alcohol. Whatever the line of local treatment, it should be followed by the iodoform-gauze packing. The so-called "dry treatment" by packing the ear full of boric acid or other powder must be condemned on account of its interference with drainage.



Clinical experience alone will enable the practitioner to decide as to which of the foregoing methods should be used in any individual case. If, however, the disease after a reasonable amount of treatment has not been cured, or gives no evidence of ultimate relief, the opening in the membrana tympani should be enlarged (if necessary), and the granulations or other pathologic products gently curetted from the tympanic cavity, followed by the simple treatment above related. This operative procedure should not in the least interfere with the ossicles. After an extended experience it has proven most satisfactory, many cases promptly recovering without subsequent discharge, and the hearing becoming quite normal. This as well as other operative measures should only be attempted by those familiar with such work. As a rule, no effort should be made to hasten repair of the perforation in the drumhead; as suppuration subsides, the gauze packing should be gradually withdrawn from the vicinity of the membrana tympani, which ordinarily heals without further attention. The naso-pharynx must receive due consideration in all cases; as also should the general health, in order to correct any physical disturbance, by the administration of therapeutic measures suitable for individual cases, including proper diet, tonics, etc.

As before mentioned, perforations situated high up in the tympanic membrane indicate a much more formidable disease than those confined to the inferior portion. Extensive granulations, with more or less necrosis of the ossicles and tympanic walls, are usually present, and in turn predispose (by direct continuity of structure) to brain or mastoid abscess; or the infectious matter may be communicated to the dura mater, causing subcranial abscess or diffuse meningitis, or to the blood-vessels in the diploë, giving rise to osteo-phlebitis, thrombosis of the lateral sinus, or pyæmia. The only effective line of treatment in such cases is an operative one, although it is well (unless urgent symptoms arise) to first institute the foregoing line of treatment. If, however, granulation-tissue and decay of bone are present, it is certainly unwise, and even dangerous, to be content with any treatment short of removing the necrotic malleus and incus, and other pathologic products from the tympanic cavity. By this procedure we establish a free drainage, and make an opening into the tympanum sufficiently large to admit of the site of the disease being properly treated; furthermore, if this rational interference be established before brain or mastoid complications have set in, these developments will almost surely have been prevented; besides, the discharge in most cases will cease, and the hearing in the majority of patients greatly improve.

The limits of this article will not permit a consideration of the technique of these delicate operations. Those desirous of further

information on this subject, and a discussion of the many complications and sequelæ arising from suppurative diseases of the ear, are referred to the comprehensive works of Burnett, Sexton, and Dench, or the forthcoming work of Laurence Turnbull.

#### CHRONIC NON-SUPPURATIVE OTITIS MEDIA.

Chronic aural catarrh is pre-eminently a disease dependent for its existence upon some catarrhal condition of the nose or throat. The mode of implication is by continuity through the Eustachian tube, both ears usually being affected, although not always to the same extent. The three principal forms of chronic catarrh seen in the naso-pharynx are dry, granular, and relaxed. The dry form is prevalent in hot, dry climates; the surface of the pharynx being so entirely devoid of moisture as to present a glazed appearance. Granular catarrh is, however, quite the reverse, the pharyngeal mucous membrane being somewhat thickened, and projected above this surface are numerous red granulations about the size of a millet-seed. The Eustachian tubes are more or less obstructed, but it is unusual to find complete obliteration of their lumen. This partial occlusion is, however, inadequate to admit the entrance of air into the tympanic cavity in sufficient volume to equalize the atmospheric pressure exerted on the drumhead through the external canal; the result being that the membrana tympani is at times so markedly retracted that it becomes adherent to the promontory of the middle ear. As the long handle of the malleus extends between the layers of the membrana tympani (to which it is firmly attached), it is evident that this excessive retraction must somewhat misplace and suspend the function of both the drumhead and ossicles, thus causing more or less severe tinnitus and vertigo, as the direct result of undue impaction of the stapes into the fenestra ovalis. Unless relief is obtained (a difficult matter in cases of long standing), this condition continues over a greater or less period of time, until finally the labyrinth or auditory nerve becomes seriously implicated, followed by the inevitable result, *deafness*, more or less complete, and generally of a permanent character.

Probably this disease, more than all others, predominates as the most frequent cause of deafness. This can be accounted for from the fact that, until it has become fairly well established, it is virtually an affection without symptoms or discomfort noticeable to the average patient. As the disease is without pain, the first symptom observed by the patient is a slow but surely progressive impairment of hearing, accompanied by a similar gradually increasing tinnitus. The deafness varies considerably from day to day, being worse in damp and cold weather. As time progresses the deafness becomes very marked;

later the patient discovers that he "hears better in a noise" (*paracusis Willisii*), as, for example, when riding on a railway train. This phenomenon indicates that the disease is well advanced, and not very hopeful as regards beneficial treatment. The absence of wax, and an unusually clean polished surface of the external canal and membrana tympani, are objective symptoms characteristic of this disease. The drumhead, however, frequently loses its lustre, and may show considerable opacity, or crescentic areas of calcareous deposits. The absence of bone-conduction renders a case quite hopeless as regards improvement in hearing power, although much can be accomplished for the relief of distressing tinnitus and vertigo.

**TREATMENT.**—The objects to be accomplished are the alleviation or cure of the naso-pharyngeal catarrh; the free admission of atmospheric air into the tympanum, and the restoration (as far as possible) of the membrana tympani and ossicles to their normal position.

Manifestly, the degree of success we may attain in one or all of these objects will depend upon the stage at which individual cases are seen. In recent cases the correction of an abnormal condition of the naso-pharynx and gentle inflation of the middle ear by Politzer's method will suffice to restore the hearing. Obstructive growths in the nostrils and post-nasal space must be removed, and every effort made to restore them to a normal condition, which will have a similar effect upon the Eustachian tubes. An alkaline wash for the nostrils and astringent gargles for the throat should be used by the patient at home. Free *nasal* respiration must be established to make other treatment effective. The application of nitrate of silver solutions in varying strengths can be made to the pharynx, as can also—

R. Tinct. iodi,	
Tinct. guaiaci,	āā. ʒj (4.);
Tinct. benzoin. comp.,	fʒj (30.).—M.

Or the following can be applied to the nostrils, the naso-pharynx, and throat:

R. Iodi,	gr. v (0.31);
Creasoti (beechwood),	℥v (0.31);
Potassii iodi,	ʒj (4.);
Glycerini,	fʒj (30.).—M.

These solutions should be applied two or three times each week, the efficiency of treatment often depending upon the variety of applications used. Injections of various fluids and vapors through the Eustachian tube into the tympanic cavity (their utility being problematical) should only be attempted by those familiar with such work.



If an apparent obstruction in the Eustachian tube does not yield to the proper use of Politzer's method of inflation it is not likely to be improved by the use of the Eustachian catheter, unless in expert hands. On the contrary, its unskilful use is capable of doing serious damage. In cases where the tube is patulous and no adhesions present, the membrana tympani can usually be restored to its position by the use of Politzer's bag, but firm bands of adhesions must be divided before we can secure liberation of the membrane and ossicles. Massage with Siegle's pneumatic speculum, or equivalent apparatus, is of some service in many cases. Hypodermic injections of pilocarpine in sufficient dose to produce profuse diaphoresis can be used with benefit when the internal ear is implicated, especially if a syphilitic tendency is manifest.

Excision of any part of the sound-conducting apparatus should only be employed when relief from severe tinnitus or vertigo is the object of such treatment. It is possible, however, in well-selected cases, to give considerable improvement in hearing, and relief of tinnitus and vertigo, by severing the adhesions between the promontory and membrana tympani, and thus re-establishing the function of the chain of ossicles and the drumhead.

## DISEASES OF THE NASAL CHAMBERS AND ASSOCIATED AFFECTIONS.

By E. FLETCHER INGALS, M. D.

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### RHINITIS.

#### ACUTE CATARRHAL RHINITIS.

ACUTE catarrhal rhinitis, also known as acute coryza, acute nasal catarrh, acute cold in the head, and acute rhinorrhœa, is an inflammation of the nasal mucous membrane. It is characterized by sneezing, hypersecretion, and more or less obstruction of the nares.

No specific germ has been discovered as a cause for this disease. From some cases one is led to believe that in certain instances the disease is infectious, as not uncommonly from one individual an entire family appears to be infected. According to Fränkel, infantile coryza is generally due to direct infection from the vaginal secretions at the time of birth. Other causes are inhalation of certain gases, hot air, and dust; exposure to the rays of the sun, eczema, measles and other fevers, and extension of inflammation from the pharynx, larynx, or conjunctivæ.

One or both nares may be involved, and the inflammation may extend into the accessory sinuses, tear-ducts, and Eustachian tubes. On rhinoscopy the mucous membrane appears red, swollen, and, if early in the disease, dry. In a very short time a profuse serous secretion appears, which later becomes sero-purulent. The nostrils and upper lip may be greatly irritated by the discharge.

General symptoms may be severe or slight. There are usually mental and physical debility and sleeplessness, partially from mouth-breathing and partially from pains and headache. The senses of taste and smell may be obtunded. From extension of the inflammation to the Eustachian tubes there are often earache, a sense of fulness or ringing in the ears, and partial deafness, all of these symptoms being generally relieved by reducing the swelling by the application of a small amount of a weak solution of cocaine, or a solution of desiccated adrenals, such as is recommended for intumescent rhinitis.

**Treatment.**—It is quite as important to treat patients between attacks as during the inflammatory process. In this way much can be done to prevent subsequent recurrence of the affection. For this purpose daily exercise in the open air, sponge baths over the chest, with cold water or salt and water, cold foot-baths, proper clothing, and avoidance of exposure to all things which have been found to excite the inflammation of the mucous membranes, are to be advised. Early in the disease a hot foot-bath, together with a bowl of hot lemonade before going to bed and 10 gr. of Dover's powder given at the same time, will usually check the pain, produce sweating, and often abort the attack. Quinine in large doses, pilocarpine nitrate (gr.  $\frac{1}{2}$ ), alcoholic stimulants, and the ammonium salts also have a reputation for aborting the attack if given early enough; but a cold twenty-four hours old can seldom be aborted.

A brisk cathartic early in the attack, especially when the bowels are confined, is of great service. Sometimes the affection may be aborted by frequent inhalations of chloroform, or of chloroform with 5 to 10 per cent. of menthol, poured out into the palm of the hand; or the vapor of ammonium carbonate, camphor, iodine, or carbolic acid. But perhaps the most satisfactory abortive treatment is large doses of quinine supplemented by the application to the nares of a small amount of cocaine, either in powder or by spray.

Totally abstaining from liquids, as recommended by C. J. Williams,<sup>1</sup> is said to cure the attacks, the nasal secretion beginning to dry up in about twelve hours, and ceasing in from twenty-four to thirty-six hours. He allowed but a half-ounce of milk or tea twice a day and an ounce of water at night.

If Turkish baths are taken, as they sometimes are with benefit, great care should be taken to avoid subsequent cold.

I have obtained the most satisfactory results by administering at first some form of opium or morphine with a large dose of quinine, this to be followed by the application to the nasal mucous membrane of 1 to 2 per cent. of cocaine in water, oil, or in a powder with sugar of milk and starch. The use of an oily spray four or five times a day protects the surfaces and greatly aids in the treatment. The patient may take three or four times a day small doses of *nux vomica*, together with camphor monobromated, and cinchonidia salicylate or quinine.

#### CHRONIC RHINITIS.

The different varieties of chronic rhinitis may be classified, for convenience of description, under the following heads: 1. Simple Chronic Rhinitis; 2. Intumescent Rhinitis; 3. Hypertrophic Rhi-

<sup>1</sup> *Cyclopædia of Practical Medicine*, London, 1883.



nitis; and 4. Atrophic Rhinitis—each of which requires its own appropriate treatment.

#### SIMPLE CHRONIC RHINITIS.

Simple chronic rhinitis is a catarrhal inflammation of the nasal mucosa attended by little or no swelling.

The patient usually gives a history of repeated attacks of "cold in the head," and states that for some time past, several months or more, he has suffered with a constant irritation in the nares. These irritations are described as itching, burning, or tickling in character. Sneezing occurs with slight provocation. The eyes often ache, and pain in the frontal region is very common. The senses of taste and smell become less acute and hearing is usually imperfect. The inflammation may extend through the tear-duct to the conjunctiva and severe lachrymation result. There is usually a profuse watery discharge from the nose occurring upon trifling irritation, such as the inhalation of cold air. Later the discharge may become muco-purulent. The general health of the patient is not usually much impaired by this affection.

On rhinoscopic examination the mucous membrane is found to be congested, the surface bathed in its own secretion, with more or less mucus collected in the nasal cavity, and at times there may be tenacious masses of partially dried secretion clinging to the walls. The naso-pharynx presents a similar condition of congestion with adhering secretions.

**Treatment.**—In spite of treatment the disease may be tedious in its course and terminate in some of the other forms of rhinitis. A cure may be sometimes established and much relief is afforded by proper treatment. The irritability of the mucosa can be relieved and the excessive secretion checked, so that even if a permanent cure is not ensured the treatment is very satisfactory.

Watery secretion serves one useful purpose—that of cleansing the nares, so that when this is present washes are unnecessary. In this class of cases soothing astringent powders and sprays are very efficacious. These applications should after a few seconds of discomfort cause a feeling of relief. They should never irritate for more than five minutes. Mild preparations can be used at first, and their strength may be gradually increased as the membrane becomes toughened. Some physicians adhere to alkaline solutions, but the oily sprays are doubtless of greater utility. Liquid albolene and oleum petrolina are most commonly employed. Melted vaseline has also been put to the same use. The effect of these oils is soothing and palliative. They should be prescribed for the patient to use freely at home two or more times a day. The addition of ten minims of terebene to the ounce of one

of the above oils is sometimes effective in checking the discharge. These sprays are best applied by some atomizer that throws a large spray, like the No. 50 Davidson (Fig. 301).

FIG. 301.



Davidson's Oil Atomizer, No. 50.

Below is a prescription for a sedative powder which may in some cases be applied once or twice a day, in addition to the spray, with decided benefit:

R. Iodol,	gr. xxv (1.5);
Amyli,	gr. ij (0.12);
Sacchari lactis,	q. s. ad gr. c (6.65);
[With or without—	
Cocainæ hydrochloratis,	gr. i-ij (0.05-0.12)].—M.

The prescription with cocaine must not, however, be given the patient so that it could be repeated, and the powder must not be employed continuously.

The sensitive areas can be best relieved by superficial cauterizations with the galvano-cautery, as in hay fever. These operations can be performed as often as once in five or seven days. Sedative powders and sprays should be used between treatments. The terminal fibres of the hypersensitive nerves are thus destroyed, but no scar is left because the mucous membrane is not burned deeply enough.

#### INTUMESCENT RHINITIS.

Intumescent rhinitis is a form of chronic rhinitis occurring more frequently than any of the other varieties. Its chief feature is the intermittent swelling of the nasal mucosa, causing more or less obstruction to nasal respiration. The swelling may be found on both sides, but usually but one side is obstructed at a time, though this



condition may change in a few moments to the opposite naris. Often, when the patient is lying on the side, the undermost cavity is occluded, but, a few moments after turning over, the opposite side stuffs up and the side formerly obstructed becomes free. Inspection will usually detect congestion of the mucous membrane, but it may appear pale. Usually the swelling or tumefaction is confined to the mucous membrane covering the inferior turbinals, but the middle turbinated bodies may also be involved, and even part of the membrane over the septum, especially that part directly opposite the turbinated bodies. It is not unusual to find the cavities temporarily free, though obstruction in one or both nares may have been noticed several times during the day or night.

In this as in other forms of chronic rhinitis we have to assign repeated exposure and acute attacks of rhinitis as the cause. The patient complains of the annoyance of mouth-breathing from nasal obstruction, attended by hawking and efforts to clear the throat, particularly in the morning and after eating, and also of dropping of mucus into the throat from the naso-pharynx. There may be little or no increase of nasal discharge. The secretion sometimes collects in the nares, and if it remains for any length of time becomes offensive from decomposition.

Intumescent rhinitis must not be confounded with the hypertrophic form, from which it can be distinguished in uncomplicated cases by the use of a 4 per cent. cocaine powder or spray thrown into the nares. This in two or three minutes reduces the swelling so that the cavities appear of normal size. So also exercise, as running up-stairs, may produce temporary reduction of the swelling. In the intumescent rhinitis the soft tissues may be pressed down with the probe until the bone is felt, the dent thus formed quickly disappearing on removal of the instrument. Nasal mucous polypi are lighter in color; they can be moved; they allow the passage of the probe on either side, and are not reduced in size by the application of cocaine.

Before considering the treatment it must be remembered that intumescent rhinitis, if left to itself, may terminate spontaneously in recovery, but that it usually lasts for months or years and at last eventuates in the hypertrophic form; also that pharyngitis and laryngitis often result from mouth-breathing, and that in many cases throat-deafness is caused by involvement of the Eustachian tubes. The effect of imperfect oxygenation of the blood upon the general health is not to be forgotten, such patients having much less endurance than those with free nasal chambers.

**Treatment.**—Great importance is attached to the prophylactic treatment of the disease. All persons susceptible to catarrhal troubles



should be very careful to avoid exposure to all causes known to produce the affection. They should wear woollen underclothing all the year round, the hot summer months alone being excepted, when silk but not cotton underwear may be substituted. Systematic exercising regularly practised, followed by cold sponging and the vigorous use of a coarse towel, together with daily bathing the feet in cold water, will be found of great service in preventing colds.

In the early stages of the affection sedative remedies regularly used, together with mild astringents or stimulants occasionally applied to the nose, may establish a rapid cure. The milder stimulating remedies, which may be applied two or three times per week, consist of solutions of zinc sulphate about gr. ij to the ounce, with or without a similar amount of carbolic acid or zinc chloride, gr. ij to gr. v to the ounce of distilled water. Milder solutions should be employed at home two or three times each day, such as boric acid gr. x to the ounce, or sodium bicarbonate and baborate, equal parts, gr. iss to gr. ij to the ounce. When a somewhat more stimulating application is desired a saturated solution of boric acid in camphor-water is excellent. Oily preparations containing camphor gr.  $\frac{1}{2}$  to j, menthol gr. ss to j, or thymol gr.  $\frac{1}{4}$  to  $\frac{1}{3}$ , are generally of more benefit than the aqueous solutions. The sedative powders mentioned under Simple Chronic Rhinitis may also be very advantageously employed in addition to this treatment.

The continuous use of cocaine in however small quantities should be avoided, both on account of the danger of forming the cocaine habit and because it seems to partially paralyze the vasomotor nerves when used for any length of time and thereby causes turgescence of the cavernous tissue of the mucous membrane and thus aggravates the affection we are endeavoring to relieve. When properly employed, however, this drug is of great advantage in relieving the acute exacerbations of the disease and causing the temporary reduction of the swelling. Cocaine is very conveniently used in powder form. This may be blown into the nares by means of a hand-insufflator, two or three times a day, in doses not to exceed gr.  $\frac{1}{30}$ . The following formula is recommended:

R. Sodii bicarbonatis,	
Sodii baboratis,	āā. gr. iss (0.09);
Amyli,	gr. j (0.06);
Cocaine hydrochloratis,	gr. iv (0.25);
Sacch. lact.,	q. s. ad gr. c (6.65).—M.

This is not to be prescribed, because of the danger that the prescription may be refilled. It is much safer to dispense the powder to the

patient so as to be able to know just how much he is using. He may also be supplied with a short glass tube about four millimetres in its internal diameter and eight or nine centimetres in length, flattened and expanded at one end but round at the other, to be used for applying the powder. He is instructed to work a small quantity into the round end of the tube by moving it about in the powder, and to slip one end of a piece of rubber tubing about twenty-five centimetres in length over the same end of the glass tube; then place the flattened end in the nostril and the free end of the rubber tube between his lips and with a short quick puff blow the powder into the nares. When the physician makes the applications it is much more elegant to use a hand-insufflator (Fig. 302). Any application for frequent use

FIG. 302.



Powder-Blower (one-third size). Two glass tubes—straight tube for nasal, bent tube for nasopharyngeal, applications.

at home should not cause discomfort for more than three or four minutes, and should be followed by relief to the patient. Stronger applications may be made every two to five days. The extract of the adrenal glands has a similar effect to cocaine in reducing the congestion and swelling of the nasal mucous membrane, apparently without the subsequent deleterious influence on the nervous system. An aqueous extract used in the form of a spray to the nares four or five times a day can be employed with advantage in many cases. Following is the formula:

Ry. Desiccated adrenals,	3j (4.0);
Acidi borici,	gr. xvj (1.0);
Aquæ camphoræ (hot),	3j (30.0);
Aquæ destillatæ (hot),	q.s. ad 3ij (60.0).—M.

Macerate for four hours and filter. This solution if kept cool will remain stable for several weeks.

Secretions that collect in large quantities in the nasal chambers should be washed away once or twice a day with an alkaline or salicylate solution, as the following:

R. Sodii salicylatis,  
 Sodii biboratis, *āā. 3vj* (24.0);  
 Sodii bicarbonatis,  
 Sodii chloridi, *āā. 3x* (40.0).—M.

Sig. ʒj (4.0) to Oj (500.0) of tepid water.

Or, Rhodes' nasal tablets, the formula for which is—

R. Potassii chloratis, gr. iiss (0.15);  
 Sodii bicarbonatis, gr. x (0.65);  
 Sodii chloridi, C. P., gr. x (0.65);  
 Sodii salicylatis, gr. v (0.35);  
 Sodii biboratis, gr. v (0.35);  
 Thymol, gr.  $\frac{1}{8}$  (0.008);  
 Eucalyptol, m  $\frac{1}{4}$  (0.016).—M.

Sig. Dissolve one tablet in glass of warm water and snuff up the nose from palm of hand once or twice daily.

An excellent alkaline solution may be made at almost any home by dissolving an even teaspoonful of sodium bicarbonate in half a pint of lukewarm water, or a similar amount of equal parts of sodium bicarbonate and sodium chloride. The former sometimes causes an uncomfortable sensation of dryness not produced by the latter. The nose having been cleansed, the applications already recommended should be made.

These remedies give temporary relief in fully developed cases, but cannot be expected to effect a cure. They are therefore advised only as an aid to more radical treatment. The most efficient treatment consists in the cauterization of the swollen tissue, either by chemical agents or by the galvano-cautery; or in the removal of redundant tissue with the steel-wire snare or scissors.

Various chemical agents have been recommended for this purpose, but strong acetic acid or chromic acid are the most useful, the latter being usually preferred. A 50 to 75 per cent. solution of the chromic acid may be used, but a better method is to place a few crystals of

FIG. 303.



Flat Nasal Probe ( $\frac{3}{8}$  size); made of aluminum, and bent at an angle of 35°.

the acid upon an aluminum probe and hold it over an alcohol or other flame so that the crystals fuse slowly and finally dry, but without burning; and then rub the fused crystals, held on the probe, over the part to be cauterized, which soon becomes of a brownish color. Any



excess of acid can be neutralized by an alkaline spray, which should always be applied immediately after the use of the acid. One should never use at one time an amount of acid exceeding one-quarter the size of a grain of wheat. It should be applied along a narrow line from ten to twenty millimetres in length.

Bosworth considers touching the membrane at separate points quite as efficient, but I have not been as much pleased with this method as with the one described. A repetition of the cauterization is not advisable until complete healing has occurred, which will require from ten to twenty days. Much more pain is produced by chromic acid than by the galvano-cautery. The wound heals more slowly and gives rise to a more irritating discharge, therefore I much prefer the latter. With the galvano-cautery an electrode is used with a blade about fifteen millimetres in length made of No. 21 platinum wire. A linear incision the whole length of the turbinated body and deep enough to just touch the bone in a few places should be made. If necessary a second and even a third incision should be made a few lines above or below the preceding one, sufficient interval being left between cauterizations to allow healing to take place. Both nares may be treated in the same way if similarly affected, the cauterizations being made in turn on alternate sides.

Whatever method is used for cauterization, the site of the operation should first be anæsthetized with cocaine. For this purpose a 4 per cent. solution should be applied by means of a small cotton pledget on the flat nasal probe referred to above; or by spreading a thin film of cotton saturated in the cocaine solution over the field of operation. Some operators apply the cocaine by spray, but either of the above methods is more accurate; I prefer the first mentioned, as with it there is less absorption of the drug. When applied on the probe the application must be repeated three to five or more times at intervals of one or two minutes apart. I prefer as a local anæsthetic the following solution:

R. Atropinæ,	gr. $\frac{1}{10}$ (0.006);
Strophanthinæ,	gr. $\frac{1}{5}$ (0.012);
Olei caryophylli,	℥ij (0.18);
Acidi carbolic,	gr. x (0.65);
Cocainæ hydrochloratis,	gr. xx (1.35);
Aquæ dist.,	q. s. ad fl ʒj (30.0).—M.

Usually when the patient cannot feel the application of the probe to the part it is ready for cauterization. It is advisable then to apply an oily spray containing about five minims of oil of cloves to the ounce. This serves the triple purpose of antisepsis, lubrication,

and protection. The cauterization can now be performed as above described, after which, to assist in repair, two or three grains of iodo should be blown into the side operated upon. A small pledget of cotton should then be placed in the nostril on the same side and the patient instructed to change this at will, but to wear it for a day or two while out of doors.

Suitable after-treatment following the cauterization, either by acid or galvano-cautery, must be employed. This consists of the use at home of a mild antiseptic spray, as, for example, gr.  $\frac{1}{2}$  of thymol, gr. ss of carbolic acid, and ℥ij of oil of cloves to the ounce of liquid alboline, or, if this proves too stimulating so as to cause pain, its strength must be reduced. The patient may also be given a 4 per cent. cocaine powder to be used for a few days only, to keep down the swelling which usually follows the cauterization, and thus avoid adhesions. For this powder I prefer the following formula :

R. Sodii bicarbonatis,	gr. j (0.06) ;
Sodii boratis,	gr. j (0.06) ;
Magnesii carbonatis,	gr. iij (0.18) ;
Cocaine hydrochloratis,	gr. iv (0.25) ;
Sacch. lact.,	q. s. ad gr. c (6.65).—M.

The patient should be directed to return on about the fourth day, when the flat probe should be passed between the site of the operation and the opposite septal wall, so as to further prevent any adhesion of the two surfaces. Cauterization may be made on the opposite side ten or twelve days later.

Coexisting laryngitis and pharyngitis should receive proper treatment at the same time. About four-fifths of the annoyance caused by this disease will disappear very soon after the nasal obstruction has been removed.

In intumescent rhinitis a slight change of climate, especially from a damp to a dry climate, will often give immediate relief, though the affection usually recurs as soon as the patient returns home.

#### HYPERTROPHIC RHINITIS.

Hypertrophic rhinitis is a chronic affection characterized by hyperplasia of the mucous and submucous tissues of the nares, causing permanent thickening of the turbinated bodies, especially the inferior, and sometimes of the septum, usually at its upper part. The thickened mucous membrane is usually congested, but may be abnormally pale, the former condition calling for sedative or astringent remedies, and the latter for stimulating applications. Exostoses, enchondroses,

or deflection of the nasal septum are frequently found associated with the hypertrophy.

The common symptoms are excessive discharge from the nostrils or into the naso-pharynx, with hawking and a constant inclination to clear the throat, and mouth-breathing upon any exertion or during sleep. Hearing is usually impaired to some degree; in fact, hypertrophic rhinitis is the most common cause of deafness. Inspection reveals a collection of mucus or muco-pus at the lower part of the cavity, and sometimes dried secretion collected in crusts on the septum or turbinated body. The former of these conditions is best relieved by mild alkaline detergent washes, the latter by the same applications supplemented by oily sprays. The vault of the pharynx appears congested, and often lodges tenacious mucus or dried masses that upon partial decomposition cause an offensive odor.

In order to direct the treatment intelligently it is necessary to distinguish hypertrophic rhinitis from the intumescent variety, syphilitic disease of the nose, and mucous polypi.

Syphilitic disease of the nose when unattended by ulceration can only be distinguished from hypertrophic rhinitis by a careful consideration of the history, the presence of other signs, and the effect of specific treatment.

Polypi are translucent, movable, and smoother than hypertrophied tissue, and the probe can be freely passed between them and the external wall.

The disease, unless properly treated, may extend over a number of years. It may terminate by atrophy in less than two years, but it is usually of long duration. The usual course is a gradual increase in the hypertrophy until the nares are much obstructed; then the disease remains stationary for a variable length of time, when at last atrophy sets in and progresses until the nares are much enlarged, though obstructed by collections of mucus that become extremely offensive. There is no evidence that it ever terminates in tuberculosis.

**Treatment.**—Until within the last ten or twelve years little or nothing of benefit was done for the hypertrophic rhinitis. Many remedies for internal and topical use have been recommended to cure the disease, but none of them are of much value, excepting when used in connection with proper surgical interference.

In order to effect a cure it is usually necessary to remove some portion of the redundant tissue. For this purpose we have several measures at our disposal. Chemical caustics, the galvano-cautery, trephines, burrs, saws, scissors, the cold-wire snare, the galvano-cautery snare, and electrolysis are all in use.

Among the chemical agents that have been used for this purpose



are nitric and sulphuric acids, London paste, solutions of mercury nitrate, glacial acetic acid, and chromic acid. All of these caustics, excepting chromic and acetic acids, have deservedly passed into disuse.

Chromic acid is very efficient, but it is open to the objection mentioned under Intumescent Rhinitis. The monochloroacetic acid is particularly useful in cases where subsequent adhesions are feared. Carbolic acid, also, injected beneath the mucous membrane, appears to have been successful in some instances. W. Scheppegeirell of New Orleans<sup>1</sup> draws the following conclusions from his experience with over one hundred cases treated by bipolar electrolyzation: That compared with other methods it is more conservative, that it effects the destruction of the tissues without destroying the mucous membrane and its glandular elements, and that it has not the disagreeable after-pain following the application of chromic acid. Being a submucous operation, the reaction following it is very slight. He has never seen a synechia formed in the nares due to the effect of electrolyzation. As the operation is not performed as rapidly and with as few sittings as by means of galvano-cauterization, it is not so practicable in cases of young children or very nervous patients. The physical conformity of some nostrils renders it difficult to properly insert the electrolytic needles, and in these cases some other method must be adopted.

The majority of cases may be successfully treated by cauterization, as already described under the Treatment of Intumescent Rhinitis. D. B. Kyle recommends the removal of a long, prism-shaped piece by two oblique linear cuts with a special knife and snare. It would seem that troublesome hemorrhage might be likely to follow such a procedure. In the hypertrophic form of the disease more cauterization may be necessary on either side, and very often the middle turbinate is involved so as to require like treatment. In cauterizing the middle turbinals, instead of linear cauterization a small loop-like or pointed electrode may be inserted in three or four places along the lower margin of the hypertrophied tissue.

If the hypertrophied tissue is sufficiently large to render the use of the snare or scissors practicable, one of these instruments, preferably the former, should be used to remove the redundant tissue. But often after the application of the cocaine the swelling is greatly reduced, and the snare does not then take hold of the tissue. Some patients will endure the pain of the operation without the aid of the cocaine, and then the use of the snare is quite practicable. The hypertrophy at the middle of the upper part of the septum can be reduced by two oblique cauterizations about one-quarter of an inch apart, from above downward and forward.

<sup>1</sup> *La Revue Internationale de Laryngologie*, 1896.

Whatever method of operation is used, it should be the effort of the physician *to save as much mucous membrane as would normally cover the parts*, and to obtain as little cicatricial tissue as possible.

The hypertrophy may be complicated by bony or cartilaginous enlargement to such an extent that removal of the redundant soft tissues alone cannot suffice to make the nares free. In such cases the bony or cartilaginous growth may be removed by knife, saw, scissors, dental burr, or nasal trephine, as directed under their respective headings.

*Submucous infiltration of the sides of the vomer* is common in chronic rhinitis. It causes some obstruction to nasal respiration, also increased secretion and constant dropping into the throat. Rhinoscopic examination reveals a yellowish-white or gray puffiness on one or both sides of the vomer near its posterior margin.

**Treatment.**—The œdematous tissue should be destroyed by cauterization, the galvano-cautery being preferred; or it may be removed by cutting forceps.

#### ATROPHIC RHINITIS.

This may be considered the fourth stage of chronic rhinitis. It is characterized by the large size of the nasal cavities and the collection of drying secretions, which give rise sometimes to an extremely offensive odor.

According to More of Winterthur,<sup>1</sup> atrophy is coincident with hypertrophic rhinitis in about 25 per cent. of the cases. In the remainder of the cases the turbinates are often of normal size, but in many cases they are smaller than normal, and in advanced cases may have entirely disappeared.

Because of the large size of the cavities and the tenacity of the altered secretion the patient is unable to expel it. Therefore it dries and forms crusts, which undergo decomposition and may completely obstruct the cavities. These crusts after a few days are separated by the secretion beneath them, and may be expelled, only later to be replaced by a like mass. The mucous membrane is usually anæmic, which condition will suggest the use of stimulating applications.

The offensive odor can in most instances be relieved in a few days, not to reappear if perfect cleanliness is observed. The anosmia and partial deafness usually associated with the disease often resist treat-

FIG. 304.



Ingals' Nasal Syringe (one-third size).

<sup>1</sup> *Archives of Otolaryngology*, New York, 1894.

ment. At least partial regeneration of the tissues takes place in some cases.

**Treatment.**—*Cleanliness* is of the greatest importance in the treatment of atrophic rhinitis, and this part is to be carried out principally by the patient. He should be directed to wash the nares thoroughly from two to four times a day, using from one to three tea-cups of fluid each time. It may suffice to snuff fluid through the nares from the palm of the hand, and this is the safest method; but if this does not clean the nares thoroughly, some form of nasal syringe (Fig. 304) or douche may be necessary; but with either of these instruments there is danger of causing deafness by forcing fluid through the Eustachian tubes into the middle ear. The syringe appears safer than the douche. While using either of these, little force should be employed; the patient should keep his mouth open and avoid swallowing. Some patients cleanse the nose with water alone, but usually it is better to use some saline solution, either sodium chloride or bicarbonate, or a mixture of the two in the proportion of a heaping teaspoonful to a pint of lukewarm water. Rhodes' tablets, four of which should be used to a pint of water, make an excellent astringent and antiseptic wash. (See Intumescent Rhinitis.)

Listerine, phenol, or other antiseptics in small quantities may be added to the saline wash if desired. After cleansing the cavities, stimulating and antiseptic powders, preceded or followed by an oily spray, have proved beneficial in my hands. Iodol alone or combined with one-tenth to one-fifth of 1 per cent. of mercury bichloride, or boric acid 10 per cent., and cocaine 2 to 3 per cent., answers a good purpose, but the most satisfactory powder I have ever employed consists of—

Yellow oxide of mercury,	$\frac{1}{4}$ per cent. ;
Iodol,	25 “
Cocaine,	2 “
Sugar of milk,	73 “

Of this one or two grains should be blown into each naris two or three times a day.

The sensitiveness of the nares will vary much in different cases, and the quantity of the mercurial will have to be increased or diminished accordingly. The powder should not cause much pain, and this should not last more than five minutes at most.

Very useful sprays are composed of liquid albolene with carbolic acid  $\mathfrak{mij}$  and menthol gr. ss, or with thymol gr.  $\frac{1}{2}$  and olei caryophylli  $\mathfrak{mij}$  to the ounce.



T. Passmore Berens<sup>1</sup> obtained encouraging results from the use of ichthyol in the treatment of a number of cases of foetid atrophic rhinitis. In severe cases he applies a large cotton tampon saturated with undiluted ichthyol, inserted into each nostril and allowed to remain fifteen minutes. The patient then finds it easy to expel most of the scabs, which latter become loosened by the copious secretion produced. All sinuosities, especially the spaces between the turbinated bodies and the outer wall of the nose, are then cleansed with cotton saturated with ichthyol, using considerable force in rubbing, thus massaging the mucous membrane with pure ichthyol. In less severe cases or where the scabbing is slight the tampon is not used.

Zinc stearate, with 25 per cent. eucrophen as a stimulant,<sup>2</sup> applied with an insufflator after cleansing, has been used with some success.

Constitutional treatment with quinine, iron, strychnine, arsenous acid in some form, and iodine is of great assistance in many cases. The iodine in sufficiently large doses to cause an increase in nasal secretion frequently gives excellent results.

### OZÆNA.

OZÆNA is a form of atrophic rhinitis characterized by an intolerable odor of the nasal secretion. The ultimate cause of the disease has not been settled. It is supposed, however, to be of microbic origin, Loewenberg's diplococcus ozæna and Abel's bacillus ozæna both having been assigned as the cause. Capart of Brussels<sup>3</sup> insists that it is contagious, but this is extremely doubtful. He claims to have often had the husband consult him some years after marriage for ozæna contracted from his wife, and that often a mother suffering from ozæna communicates the affection to her children by allowing them to use her handkerchief. Heredity seems to play an important part in the causation of the disease, and there can be but little doubt that it is generally preceded by hypertrophic rhinitis.

The mucous membrane of the nose is deficient in secreting glands and thin, tender, and often ulcerated at some point. The nasal cavities are larger than normal, and the surface is more or less covered with dry decomposing crusts which can only be removed by the most careful washing. The treatment is essentially the same as that for ordinary atrophic rhinitis, though it must be more assiduously employed.

Muschold<sup>4</sup> especially recommends a spray consisting of pure glyce-

<sup>1</sup> *American Medico-Surgical Bulletin*, July 1895.

<sup>2</sup> Gibbs of Philadelphia: *Medical News*, December, 1894.

<sup>3</sup> *Journal de Médecine, de Chirurgie, et de Pharmacologie*, July, 1895.

<sup>4</sup> *Revue internat. de Médecine et de Chirurgie*, Paris, April, 1899.

rin 7 parts, sodium borate 20 parts, and water 30 parts. The glycerin prevents the formation of crusts by causing an abundant watery secretion, and the sodium borate prevents the decomposition of the exudate. The cavities are then to be cleansed by an applicator armed with cotton, and the spraying repeated so as to reach the entire nasal cavities. The patient should use the atomizer three times a day. Under these applications the odor is said to vanish in a few days.

Mackenzie of Edinburgh<sup>1</sup> claims to have successfully treated many cases of ozæna by curetting away the diseased membrane, which he says was replaced by healthy mucous membrane.

Bipolar electrolysis is recommended by some as a cure. The following technique is employed. After local anæsthesia is established an aseptic copper needle is inserted well into the middle turbinate body and a steel needle as far as possible beneath the mucous membrane of the inferior turbinal of the same side. The length of the sitting and strength of current vary with the severity of the case and the sensitiveness of the patient. A twenty milliampère current for twenty minutes is recommended. One, or several sittings at intervals of two weeks, may be sufficient to establish a cure.

### RHINITIS MEMBRANOSA.

RHINITIS fibrinosa is an inflammation of the nasal mucous membrane characterized by the formation of a membranous exudate, producing nasal obstruction and giving rise to the symptoms of acute rhinitis, with some constitutional depression. It is generally due to infection with pus microbes or von Hoffman's attenuated diphtheria bacillus, but it may be caused by chemical irritants.

The disease generally lasts for from two to five weeks, and sometimes for several months. No case has terminated fatally. Mild detergent washes or sprays should be freely employed, and non-irritating powders containing about 25 per cent. of iodol, with from 25 to 50 per cent. of trypsin, papain, or other digestive agent mixed with sugar of milk, should be applied three or four times a day. None of these remedies, however, has decidedly beneficial effects on the disease.

### HAY FEVER.

HAY fever, known also as hay asthma, rose cold, rhinitis hyperæsthetica, and catarrhus æstivus, is one of the neuroses occurring periodically at particular seasons. It is characterized by irritation

<sup>1</sup> *British Medical Journal*, April, 1895.

of the mucous membrane of the eyes, nose, and air-passages, accompanied by excessive secretion and usually by asthmatic attacks.

In America the disease prevails from about the middle of August until the latter part of September, or until early frosts. Isolated cases may, however, occur at any time during the year.

There are three important factors in the etiology of the disease: First, nervous temperament; second, abnormal sensibility of the respiratory mucous membrane; and third, certain irritating substances suspended in the atmosphere.

As first pointed out by Wm. H. Daly of Pittsburg, an undoubted relation exists between hay fever and certain pathological conditions of the nasal passages that may often be removed by appropriate treatment. Odor of roses and other fragrant plants are to be given an important place among the irritating elements which commonly excite an attack. Other excitants are the pollen of *Ambrosia artemisiæ folia*, known also as Roman wormwood, rag-weed or hog-weed, or that of *Solidago odora*, known commonly as golden-rod; also dust and smoke, especially that of the railway; the pollen of certain grasses, as wheat, rye, oats, barley, or even Indian corn; also the dust of ipecac, salicylic acid, benzoic acid, and lycopodium.

Though due importance must be ascribed to the neurotic element of the disease, and as well to external irritants, the local condition of the nasal mucous membrane must not be overlooked. There exists in most, if not all, cases a hyperexcitability of the nasal lining that must be allayed to cure the disease. The attacks often return on exactly the same date of succeeding years, regardless of the temperature or other surroundings. But in many persons there is a variation of a few days, apparently dependent upon atmospheric conditions or the advance or delay of the season, so that when the summer is unusually early prophylactic measures should be adopted a week or ten days earlier than in other years.

There are two well-marked types of the disease—the *catarrhal* and the *asthmatic*—that demand different modes of treatment. The catarrhal form usually comes on with a sudden irritation of the mucous membrane of the fauces, conjunctivæ, and nares, accompanied by frequent sneezing. In the latter type asthmatic symptoms may develop very early, but usually not until after the nasal symptoms have existed two or three weeks. Often the nasal symptoms disappear, not to return again for the season, as soon as the asthma is developed.

The asthma in this affection is likely to occur during the daytime, instead of at night, and is usually worse on damp, hot days. The asthmatic type of the disease seldom develops until the patient has suffered from the catarrhal variety for from three to ten seasons.



Hay fever occurring in young children and for the first time in adults may be very hard to diagnose, but the detection of exquisitely sensitive areas of the nasal mucous membrane by lightly touching it with a probe may serve to clear up the diagnosis.

The attacks vary daily in severity, and usually continue from four to six or eight weeks, and may leave the patient in a debilitated condition for several months. After disappearance of the catarrhal symptoms the asthma may continue for a few hours or days and disappear suddenly, or it may last with incomplete intermissions until early winter. Most persons may escape the attacks of hay fever by early change of climate, but the disease is apt to recur on return to the same locality during the hay-fever season. Some patients become less susceptible to the disease as they grow older. The affection, *per se*, is not dangerous to life, but the depression it causes may favor the development of serious disease.

#### TREATMENT.

As just stated, most patients may escape the hay fever attacks by a suitable change of climate. Even a change from the country to the city or *vice versa* is sufficient with certain individuals. For most persons, however, the greatest relief is afforded in cool localities, such as are found along the Northern lakes, near the seashore, or at high altitudes where the land is not cultivated. Lake or ocean voyages will relieve some promptly, but the symptoms are very often aggravated by exposure to the wind and bright sunshine on the inland lakes. In America the most popular resorts for hay-fever patients are in the White Mountains of New Hampshire and in the region about Mackinac or Petoskey, Michigan. In fact, any place in the northern part of Michigan or Wisconsin where there is no cultivation would be a suitable place in which to live while the disease is prevalent. After the harvest the stubble-fields become covered with rag-weed, which is apparently the most obnoxious of all the exciting causes, and as soon as any locality becomes much settled it is likely no longer to afford immunity from the disease.

No locality will be found suitable for all individuals alike, as some are affected more than others by the various exciting causes. As most of the patients are of a neurotic temperament, nerve-tonics are indicated, and it is better to begin their administration a month before the attack is expected, and to continue them until convalescence is established. Abercrombie<sup>1</sup> claims to have prevented the attacks for two successive years in one neurotic case by the administration of 3 grains of valerianate of zinc three times a day after eating. The various preparations of quinine, strychnine, or arsenous acid, and *asafoetida*

<sup>1</sup> *British Medical Journal*, 1896.

or some of the preparations of valerian, are most serviceable in warding off the attacks and in mitigating the nervous symptoms in those who are affected. When the attacks are due to sensitiveness of the nasal mucous membrane they may be much mitigated by applying to the sensitive areas a strong carbolic-acid solution once in four or five days for about three weeks previous to the expected attack. This treatment should be supplemented by the use of the above-mentioned nerve sedatives and tonics.

The following application has also been recommended for the same purpose. Bichloride of mercury, gr. ij (0.06); hydrochlorate of quinine, gr. xxx (1.05), and glycerole of carbolic acid, ʒj (4.05). Either of these applications should be preceded by a local anæsthetic.

During the attack opium and belladonna, though either may give the patient great discomfort, are nevertheless often of great benefit. Atropine or hyoscyamus in small doses is especially beneficial in checking the profuse secretion and the tendency to sneeze. The local effects of inhalations of iodine, chloroform, or alcohol are occasionally very satisfactory. Weak solutions of lead acetate are recommended by Mackenzie for relieving the itching of the conjunctivæ. A solution of sodium biborate, grains 5 to 10, or of boric acid, grains 10, to the ounce of camphor-water, is most beneficial for this purpose. This can be used as often as desired for bathing the eyes. The lips and nostrils may be protected from the irritating effect of the secretion by applying the ointment of zinc oxide.

The nasal mucous membrane may be protected from severe irritation in some cases by wool plugs inserted in the nostrils to exclude the irritating substances. A spray of a saturated solution of boric acid will sometimes be found very grateful to the nasal mucous membrane. In some instances boric acid in camphor-water is better; in others the addition of small quantities of atropine, morphine, or cocaine may be necessary before much relief is experienced. In still other cases oily sprays are found more beneficial. A preparation containing about  $\frac{1}{2}$  grain of thymol and about 3 minims of oil of cloves to the ounce of liquid albolene is most excellent. In some cases a small amount of the alkaloid of cocaine—not more than one-half of 1 per cent.—may be added with advantage. For general application a powder containing 3 or 4 per cent. of cocaine will be found more convenient. Care must be taken not to administer more than one-third of a grain of this drug a day, and even this dose should not be long continued. Patients are inclined to use the drug to excess, and on this account physicians should never give written prescriptions that may be refilled, and they should know exactly how much the patient is using. The aqueous extract of the adrenal glands, as recommended for intumescent rhinitis, can be employed to

great advantage in many cases, and in a considerable number it will quickly cut short the attack.

The disease may often be cured by judicious operative measures. These include the removal of nasal polypi or any spur from the septum that impinges upon the outer wall, linear cauterization along any hypertrophied or tumefied turbinated bodies, and, most important of all, the superficial cauterization of all places found to be extremely sensitive.

The superficial cauterization should be done with a flat electrode guarded on one side, so as to prevent burning the opposite wall, and should simply sear the mucous membrane of an area not more than ten or fifteen millimetres in diameter. It should be done so as not to destroy the mucous membrane and leave cicatricial tissue. The cauterized part should be outlined on a diagram of the sensitive areas previously made. After four or five days a similar cauterization should be made over some other part of the sensitive area, preferably in the opposite naris. These operations should be repeated from time to time until the sensitive areas are completely covered and no part remains peculiarly sensitive to the probe.

After the cauterizations, as in the treatment of hypertrophic rhinitis, the patient may use a powder containing 3 or 4 per cent. of cocaine four or five times a day for a few days, and also an oily spray similar to that recommended above.

It may be necessary to perform from fifteen to thirty cauterizations in order to cover all of the diseased surface, and the following year a few spots may be found still sensitive, and these must be treated in a like manner. This treatment is not advised during the course of the hay fever, but is best carried out a few months preceding the attack.

From 40 to 50 per cent. of the cases thus treated are cured, about 25 per cent. are greatly benefited, and the remainder are sufficiently relieved of the nasal symptoms to well repay them for their discomfort during treatment.

Chronic acid, carbolic acid, and other caustics have also been recommended for cauterization of the surfaces, but they are much less satisfactory in their results than the galvano-cautery.

A change of climate during the season is to be made if possible, especially in cases of children, in whom there is reason to believe that the disease may be cured.

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### EPISTAXIS.

EPISTAXIS consists of hæmorrhage from the nose, and has its origin either in the nasal cavities or the adjacent sinuses.

The bleeding may come from the turbinated bodies, from the



posterior nares, from the adjacent sinuses, or from the fragile surface of fibrous or malignant tumors, but usually from an erosion or ulcer on the cartilaginous septum. From these various conditions it will be seen that it is important to understand thoroughly each case before we attempt radical treatment.

The constitutional causes, such as anæmia, plethora, eruptive and relapsing fevers, diphtheria, scurvy, purpura, hæmophilia, phosphorus-poisoning, acute yellow atrophy of the liver, Bright's disease, rheumatism, gout, and at times syphilis or chronic alcoholism, demand proper treatment.

Most cases terminate spontaneously within five to fifteen minutes; therefore we must be careful not to ascribe too much virtue to the method first employed for stopping the flow. But in some instances the bleeding continues for several hours or days.

Epistaxis in children from no apparent cause, and that from injuries, is seldom if ever dangerous. Occurring in old people without injury or inflammation, it indicates a degeneration of the vessels and may prove serious. In subjects of hæmophilia bleeding is liable at some time to terminate fatally.

**Treatment.**—In most cases treatment is not necessary. When the bleeding is of a vicarious nature, in plethora, and in old people with atheromatous arteries it should not be checked unless it continues so long as to cause danger from anæmia.

When it becomes desirable to check the hæmorrhage we direct the patient to sit with the head erect, remembering that gravity plays its part here as elsewhere. The mere changing from the recumbent to the sitting posture, or holding the head erect instead of leaning over a wash-bowl, is frequently sufficient to arrest the flow of blood.

The bleeding in mild cases may be readily checked by cold applications to the back of the neck or directly to the nose, or by irrigation of the bleeding naris with hot water at a temperature of 120° to 125° F. As the bleeding is usually from a small point on the cartilaginous septum, continuous compression of the *alæ nasi* or of the septum for ten or fifteen minutes will often check it. Compression of the facial artery is also recommended, the artery, in certain cases, furnishing the blood-supply to the bleeding part.

In continued or severe bleeding other methods must be adopted. The insufflation of powdered matico-leaves or small quantities of tannin, or spraying with solutions of alum, 30 grains to the ounce; or tannin, 10 grains, or perchloride of iron, 20 minims to the ounce, will be found efficient in some cases. A spray of the solution of adrenals, as recommended for intumescent rhinitis, will usually stop the bleeding quickly. For continued hidden hæmorrhage hydrogen peroxide or hydrozone has been recommended. A drachm or more,

injected into the bleeding nares, is said to give almost immediate relief. It may also be applied on a loose plug of absorbent cotton. Maizonda<sup>1</sup> in a severe case of epistaxis, the ordinary remedies being unsuccessful, tried refrigeration by spraying ether into the nares, with the result of checking the bleeding.

Simple plugging of the nostril with cotton or lint and holding the head forward until coagulation has taken place is often sufficient. When the above measures fail it is necessary to plug the posterior naris, or, better still, fill the whole naris with a styptic antiseptic gauze tampon.

MacNamara in the epistaxis of purpura recommends a wine-glassful of spirits of turpentine in a tumbler of brandy- or whiskey-punch.

In epistaxis from other causes internal remedies may be given, together with the local treatment. For this purpose ergot, opium, and lead acetate are useful. To prevent recurrence advise the patient to avoid picking the nose, prescribe warm douches and oils, and apply nitrate of silver, gr. x-xl to the ounce, or monochloroacetic acid, to the ulcer or abrasion; or, better still, with the galvano-cautery, the point of which should be heated to a cherry-red, touch the bleeding point until the surface is thoroughly seared.

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### NASAL MUCOUS POLYPI.

NASAL mucous polypi are myxomatous tumors which grow from some part of the nasal mucosa. They usually spring from the middle meatus or the external surface of the middle turbinated, though in a considerable number of cases they grow from the superior turbinated and superior meatus or from the ethmoidal cells. They occasionally take their origin in the antrum or frontal sinus, and very rarely start from the septum. They are commonly pedunculated, but usually sessile.

These patients suffer from increased nasal secretion and more or less occlusion of the nasal passages, aggravated by damp weather or by colds in the head. Headaches are common, and the senses of taste and smell are often obtunded. The voice may lack the nasal resonance, and the patient may breathe through the mouth. A profuse watery discharge is common, and epistaxis is not infrequent.

Mucous polypi are to be distinguished from deviation of the septum, thickening of the turbinated bodies, chronic septal abscesses, foreign bodies, and from fibrous and malignant tumors.

The affection, if not relieved surgically, continues for a lifetime.

<sup>1</sup> *Le Bulletin médical*, Paris.

though spontaneous expulsion of one or more polypi may occur. They are likely to recur after removal, but local medication appears of some service in preventing this.

**Treatment.**—Numerous topical applications have been suggested for the cure of polypi, and various substances have been injected into them for their destruction. Among the latter are zinc chloride, iodine, alcohol, carbolic acid, and solutions of iron perchloride. The application of saturated solutions of potassium bichromate and the introduction of chromic acid into the tumor have also been recommended. Success appears to have occasionally followed these methods, but they have certainly generally failed; therefore we must resort to operative procedures in all cases when the polypi cause inconvenience.

Evulsion with forceps, the oldest method, is still commonly practised, but should give way to the more precise methods practised by laryngologists.

The galvano-cautery *écraseur* (Fig. 305) affords the advantage of searing and thus destroying the base of the polypi. The instrument

FIG. 305.



Galvano-cautery Handle with Écraseur Attachment (one-quarter size).

is, however, rather clumsy, compared with the ordinary steel-wire snare (Fig. 306), some form of which is now in general use by laryn-

FIG. 306.



Ingals' Snare, with extra Tubes (one-quarter size, angle 25°).

gologists. It should be armed with No. 5 piano wire. The loop is passed from beneath up about the polypus, and with a backward and forward movement is worked up as near the base as possible. The loop is then firmly tightened and the polypus pulled off, unless it happens to be attached by a broad base, when it must be cut off with the wire. Sometimes both cavities may be cleaned at once, but it is better to remove what growths are in easy reach, and complete the operation in one or more subsequent sittings.

Occasionally, if not usually, the polypi bud again after removal, in which case the best treatment consists in thorough searing with the



galvano-cautery while the buds are still small. For the primary operations or cauterizations the parts should first be thoroughly anesthetized with a 4 per cent. solution of cocaine, which is best applied by means of a hypodermic syringe fitted with a long blunt silver nozzle (Fig. 307), bent at the end so that the solution may be thrown up about the base of the tumors. After removal of the polypi we should make free use of a spray containing  $\frac{1}{2}$  grain of thymol, 3

Fig. 307.



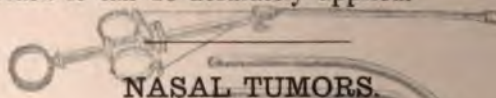
Hypodermic Syringe (one-half size). Silver nozzle.

minims of the oil of cloves, and 10 minims of terebene to the ounce of liquid albolene, which keeps the part clean and appears to have some effect in preventing recurrence.

Often operative procedures must be repeated several times until complete destruction of the growth is effected.

#### NASAL FIBROUS POLYPI.

Fibrous polypi are of extremely rare occurrence in the nose, but are not uncommon in the naso-pharynx. They are harder and bleed more easily than mucous polypi, and are not at all subject to medical treatment. They should be removed when possible by the natural passages by scissors, snare, or, better still, by the galvano-cautery écraseur, provided it can be accurately applied.



#### NASAL TUMORS.

NASAL papillary tumors are quite infrequent, but are occasionally found, varying in size from one to fifteen millimetres in diameter, and springing from the septum or lower turbinated body. They occasion symptoms of dry catarrh, with the signs of more or less obstruction.

**Treatment.**—These growths may be destroyed by nitric, acetic, or chromic acid, the curette, or the galvano-cautery, but in some cases they promptly return in spite of the most careful operations. In a most obstinate case of the kind I have seen, speedy cure from the application to the warts, two or three times daily, of the fluid extract of *Thuja occidentalis*, and the internal administration of drachm dose of the same. It is impossible to explain the *modus operandi* of this drug, but there can be no doubt of its beneficent effects, at least in some cases.

**NASAL VASCULAR TUMORS.**

Angiomata or vascular tumors of the nose are very rare. They do not appear amenable to medicinal treatment. Care must be taken in their removal to avoid after-bleeding. If the cold-wire snare is used, the process of removal should occupy many minutes or even one or more hours. It would seem that the galvano-cautery would be the best instrument in these cases.

**NASAL CARTILAGINOUS TUMORS.**

True cartilaginous tumors, or ecchondromata, are seldom found in the nasal cavities, but a few cases have been reported. They closely resemble fibrous polypi; they are, however, sessile, generally growing from the cartilaginous septum, and if not interfered with may attain enormous size, causing great deformity of the face. The tumor is hard, but can be readily penetrated by a needle and does not bleed easily. If detected early before great deformity has resulted, the prognosis is favorable.

Treatment.—They may be removed most satisfactorily by the galvano-cautery *écraseur*, but may be destroyed by electrolysis.

**NASAL BONY TUMORS.**

These very rare tumors are usually ovoid in form, and may be from a few millimetres to several centimetres in diameter, and may be dense or cancellous in structure. They usually have but little if any bony attachment, but are covered by periosteum and mucous membrane. These growths, as a rule, soon cause intense itching, which is later followed by nasal obstruction, offensive discharge, impairment of the sense of smell, frequent epistaxis and pressure-symptoms.

Treatment.—The treatment must be operative. After crushing the softer forms by means of strong forceps, the fragments may be removed. The hard variety, which is more common, may be ground down or drilled through with the dental burrs or trephines, and subsequently broken; but if very large, an external incision is usually necessary for their removal.

**NASAL MALIGNANT TUMORS.**

Malignant tumors of the nose are characterized by rapid growth, severe pain, nasal obstruction, offensive discharge, and frequent epistaxis. They are generally sarcomatous, but may be carcinomatous. On inspection their surface appears rather pale, nodular, or raspberry-like, and bleeds easily when touched with a probe.

These tumors cause alterations in the voice and other symptoms common to all nasal tumors. As the tumor grows the bony structures of the nose may be separated or pushed forward. The eyeballs may protrude and the tumor extend to the brain. Constitutional symptoms and the usual cachexia may follow later. If removed by operative measures, these growths speedily return, and usually run a rapid course, terminating fatally within six months.

**Treatment.**—Solatives and astringents may be applied for palliative effect. Treatment by injections of toxins of erysipelas and bacillus prodigiosus has not proved successful. Thorough eradication, when practicable—which unfortunately is not often the case—is the only treatment that affords any chance of success.

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### SYPHILIS OF THE NOSE.

SYPHILIS of the nose is a local manifestation of constitutional syphilis, and may be primary, secondary, tertiary, or congenital.

Primary syphilis of the nose is rare. In the secondary stage there are profuse offensive muco-purulent secretion and more or less nasal obstruction, calling for frequent washing of the parts. Condylomata are sometimes present, and mucous patches are occasionally seen at the angle of the nostril or on the mucous membrane, and the fauces usually show evidence of the disease. In the tertiary stage necrosis of the cartilaginous or bony septum or of the turbinated bodies occurs, accompanied by a most offensive odor of dead and decaying tissue. The dead bone presents a blackish, rough surface, which imparts a grating sensation when palpated with the probe. In rare instances, even when no dead bone is present, an offensive odor continues, even though the parts are kept clean by frequent washings. This condition can only be relieved by the free use of deodorants, such as thymol and aristol.

The odor of atrophic rhinitis, though offensive, differs from the penetrating stench of syphilis, and no necrosed tissue is found in the former disease.

**Treatment.**—For the treatment of the secondary stage mild constitutional remedies, together with local applications of tincture of iodine or silver nitrate to the mucous patches or condylomata usually suffice. More vigorous treatment, both constitutionally and locally, is demanded in the tertiary stage. Potassium iodide and sodium iodide in moderate doses, steadily increased if necessary up to their physiological limit, are of the utmost importance. In all cases some form of specific medication should be continued for about a year after active symptoms have disappeared. During the active disease of the nose the parts should be thoroughly cleansed two or three times a day with



some alkaline wash. Topical applications of silver nitrate, gr. xl to 1 to the ounce, of sulphate of copper, gr. x to xx to  $\frac{3}{4}$ , or full-strength tincture of iodine, should be made every day or two, if deep ulceration exists.

If dead bone is present, it must be carefully removed with forceps provided this can be done without force, or parts that cannot be thus removed may be cut away when within reach of the bone-forceps.

CONGENITAL SYPHILIS OF THE NOSE usually appears within the first month after birth, and seldom later than the second month, but occasionally not until the eighth year or even later. The early symptoms are those of cold in the head with coryza, but within a few weeks the secretion becomes thicker, causing obstruction to nasal respiration and emitting an offensive odor. Caries may ensue, causing disfigurement and extreme fœtor. Such children usually suffer from marasmus, and they are generally short-lived, but some are apparently cured.

Potassium iodide and preparations of mercury are indicated internally for their specific effects, and if possible local treatment should be carried out as recommended for syphilitic disease of the nose in adults. Ferruginous and bitter tonics, with malt, cod-liver oil, or other nutrients are of quite as much importance as the specific medication.

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### TUBERCULOSIS OF THE NARES.

THIS rare affection is characterized by the formation of tubercles of varying size, followed by ulceration and a fœtid discharge. It is caused by the bacillus tuberculosis, and is usually secondary to some other tubercular process. Thickening of the mucosa, with or without ulceration, is commonly present. The tubercles vary from two to thirty millimetres in diameter, but they are generally small and of a grayish-white color. The ulcers that follow may be single or multiple, and have a smooth grayish base and frequently raised edges. These ulcers are apt to appear upon the ala. The affection begins insidiously, and generally progresses slowly. The ulcers become painful, and later constitutional symptoms develop from the presence of tuberculosis of the lungs or larynx.

The diagnosis depends upon finding tuberculosis in other parts or upon detecting the bacilli in the discharges or scrapings from the ulcers. The disease may extend over many years. When other organs become involved, it runs a more rapid course, terminating fatally.

**Treatment.**—Tumors which obstruct the nares should be removed.

Lactic acid in varying strength, from 30 to 50 per cent., is of service in healing up the ulcers. The system should be fortified by tonics, and carbonate of creasote, oleum caryophylli, or other antiseptics should be given internally in large doses long continued.

### LUPUS OF THE NARES.

**PATHOLOGISTS** now generally recognize lupus as a tubercular disease, but there is still much doubt on the subject, so we here describe it briefly under the old name. The disease usually begins on the cartilaginous septum in the form of small red, irritable nodules. These gradually coalesce, forming uneven patches which later become ulcerated. The disease slowly invades the surrounding tissues, destroying soft tissue, cartilage, and even bone. While the destruction is extending a process of healing by white scar-tissue may be taking place at some points. The disease is not usually painful, but is accompanied by more or less offensive discharge, demanding mild alkaline detergent washes.

**Treatment.**—The local treatment consists in the removal of the diseased tissue with knife, curette, caustic, or the galvano-cantery. After thorough curetting lactic acid may be applied repeatedly until the reparative process is established. Nitric acid, caustic potash, and zinc chloride are also sometimes used for the same purpose.

## DISEASES OF THE NASAL SEPTUM.

### DEFLECTION OF THE NASAL SEPTUM.

**DEFLECTION** of the nasal septum is one of the most common deformities of the nose. It is usually associated with thickening of the cartilage and bone or enchondroma and exostosis.

The cartilaginous septum, and sometimes the bony septum, or even both parts, may be bent to one side, the cartilaginous portion, as a rule, being chiefly involved. One naris is thus enlarged at the expense of the other. There is usually thickening of the septum, especially at the lower part of the concave surface. Comparatively few cases can be traced to injury, and I agree with Delavan that in most cases it is due to hypernutrition brought about by chronic congestion of the part. The patient seeks relief because of the obstruction to nasal breathing, collection of secretions in the nares and naso-pharynx, and the nasal twang to the voice.

**Treatment.**—Operative measures alone are capable of accomplishing much good in this affection.

In slight deviations most excellent results may be attained by making a crucial incision through the cartilage, the cut being made



obliquely so that the bevelled edges will easily slide past each other. The septum is then forced into place by forceps (Fig. 308); the vomer

Fig. 308.



Ingals' Septum Forceps (one-half size).

being fractured if necessary, and a gutta-percha plug or tube of sufficient size is kept in the obstructed nostril until union has taken place. In cases where the cartilage is bent almost at right angles the mucous membrane may be dissected up, a triangular piece of cartilage excised, the cartilage incised farther back to destroy its resiliency, and a plug placed in the obstructed nostril. Even then the cartilage may return to near its former position and prevent a satisfactory result.

Incisions made by a small trephine beneath the mucous membrane, and the removal of the cores thus made, seem to destroy the resiliency of the cartilage better than other means. The after-treatment is the same. Perfect results are difficult to obtain.

#### ENCHONDROMA AND EXOSTOSIS OF THE NASAL SEPTUM.

Enchondromata and exostoses of the nasal septum consist of thickening of the cartilaginous and bony parts of the septum with a more

Fig. 309.



Adjustable Nasal Saw.

or less prominent outgrowth or spur in most cases, and usually some deflection. The spur may be small, or so large as to impinge upon the outer wall of the naris and produce severe neuralgic pains.

**Treatment.**—The obstruction may be completely removed by suitable operation. Before operating both surfaces of the septum should be anesthetized by the application of cocaine. An effort should be made to save as much mucous membrane as possible. Enchondromata may be cut away with the knife or by the trephine.



They can also be thoroughly removed in from one to three sittings without hæmorrhage by electrolysis.<sup>1</sup>

Exostoses may be removed by saw or trephine and burr. The saw (see Fig. 309) is quicker and more accurate, and should be employed when possible. Perforation of the cartilaginous septum should always be avoided, and an opening in the bony septum should not be made if sufficient room can be secured without it.

#### PERFORATION OF THE NASAL SEPTUM.

Perforation of the septum is often found as a result of syphilis, but it also not infrequently occurs in persons of low vitality or following typhoid fever, pneumonia, and phthisis.

**Treatment.**—The treatment consists in making suitable applications to heal any ulceration which may be present. Operative interference is not necessary, would be very difficult, and would result in very little if any good.

#### HÆMATOMA OF THE NASAL SEPTUM.

Hæmatoma is the name given to a collection of blood between the deep layers of the mucous membrane and the underlying cartilage of the nose. It usually results from fracture of the bony or cartilaginous septum, and presents a smooth, purple swelling just within the nostril, usually soft and fluctuating, and symmetrical on both sides. Hæmatomata usually eventuate in a few days in abscesses, and terminate with recovery, leaving a perforated septum as a rule.

**Treatment.**—First try cold applications. If suppuration takes place, evacuate upon one side, this usually being sufficient to drain both sides.

#### ABSCESS OF THE NASAL SEPTUM.

These abscesses may be acute or chronic. They are found in the same position as hæmatomata, just described. They may result from the latter or follow simple inflammation of the parts. Redness and swelling of the dorsum of the nose and neighboring parts always exist. The treatment is essentially the same as that of hæmatomata of the septum.

#### FOREIGN BODIES IN THE NOSE.

BEANS, peas, buttons, or pebbles are the most common foreign bodies found in the nose. They are usually placed there by children, and often by insane people. Occasionally bodies are lodged in the nose during the act of swallowing. They sometimes remain a long

<sup>1</sup> Casselberry, *New York Medical Journal*, Aug. 31, 1895.

time without symptoms, but substances which absorb moisture soon swell and obstruct the nose. These bodies often cause headaches, but the most characteristic feature is a more or less profuse and offensive discharge from one nostril. The application of cocaine often assists in detecting foreign bodies. Such cases are often treated for months, or even years, with douches or sprays by careless physicians, but necessarily without benefit.

**Treatment.**—The nasal cavity should be cocainized and the substances removed with forceps, catheter, probe, hooks, screws, douche, or snare, the latter being the most generally applicable. Mild alkaline antiseptic washes may be used for a week or ten days thereafter.

#### RHINOLITHS.

Rhinoliths are concretions in the nasal cavities. Phosphate of lime is gradually deposited around a foreign body, forming a rhinolith, which is hard and rough on the surface and often softer toward the centre.

The symptoms are similar to those caused by a foreign body.

**Treatment.**—They may usually be removed with polypus-forceps or the snare, or they may sometimes be crowded back into the nasopharynx and thus expelled. If necessary, they can be broken up by means of nasal bone-forceps and removed in fragments. The same after-treatment is desirable as for foreign bodies.

#### MYIOSIS NARIUM.

MYIOSIS narium, or maggots in the nose, results from the hatching of eggs deposited by flies in or near the nostril. This disease usually causes much destruction of the soft parts and may destroy even the bone. There is offensive discharge, severe pain, insomnia, and occasionally convulsions. The mucous membrane becomes first irritated, then crawling sensations may be experienced. Inspection of the nares reveals the presence of the maggots. As many as two or three hundred have been expelled from the nose in a single case. If neglected, the case may prove fatal.

**Treatment.**—Inhalations of chloroform may suffice for the destruction of the parasites. But if this is not sufficient, the patient should be anesthetized and pure chloroform injected into the nasal cavities with a syringe. This does not appear to injure the mucous membrane severely, but would be very painful without complete anesthesia. Bond of London<sup>1</sup> successfully used dilute Mandl's solution, 15 minims to the ounce.

<sup>1</sup> *Journal of Laryngology*, May, 1896.

### DISORDERS OF THE SENSE OF SMELL

**PAROSMIA** is a perverted sense of smell, the patient experiencing sensations of odors, usually disagreeable, which are not present. It is quite common among epileptics and the insane. It may be present constantly or only at times.

The disease is very frequently associated with anosmia, and may have for its seat the distribution of the olfactory nerves, in which case local treatment, as described under Anosmia, may yield satisfactory results.

Anosmia is the loss of the sense of smell. It is dependent upon obstruction in the nares or disease of the olfactory nerves or the cerebral centres. It may be unilateral or bilateral, and may come and disappear for a time, and return again, without apparent cause. When due to mechanical obstruction, anosmia disappears with the removal of the cause. When due to catarrhal inflammation of the nasal mucous membrane, recovery usually occurs, unless it is of two or three years' standing. If of cerebral origin, recovery seldom occurs.

**Treatment.**—The cause should be removed if possible. When this cannot be detected, Mackenzie recommends the insufflation of a powder containing  $\frac{1}{4}$  grain of strychnine with 2 grains of starch twice a day if necessary. Joel of Mont-Dore<sup>2</sup> cured two cases of loss of smell and taste which had existed for several months, and which had been unsuccessfully treated by irrigation, the galvanocautery, electricity, and strychnine insufflations, by the employment of carbon dioxide gas applied by an ordinary seltzer siphon. This was turned upside down, the excess of liquid allowed to escape through the tap, and the orifice then placed close to the nostrils.

### DISEASES OF THE ANTRUM OF HIGEMORE.

**TUMORS** of the antrum are not at all uncommon. They usually originate from the alveolar border. They are, in the order of frequency, carcinomata, sarcomata, osteomata, fibromata, myxomata, and cysts.

Benign growths can be removed by exposing the interior of the antrum through the necessary incision and opening into its anterior wall.

In malignant growths the operation consists essentially of removal of the upper jaw. In many cases operation is contraindicated on account of the age of the patient, his low vitality, or the involvement of inaccessible parts; in which case nothing but palliative measures can be employed.

<sup>2</sup> *London Lancet*, 1895.



EMPHYEMA OF THE ANTRUM OF HIGHMORE.

Empyema or abscess of the maxillary sinus is a common affection resulting usually from caries of the root of a tooth, but also from inflammatory lesions of the nares, and sometimes from nasal polypi. The affection is attended by pain radiating in various directions from the seat of the disease, swelling of the overlying tissues, in some cases more or less obstruction to the nose, discharge from one nostril, and a foul smell or taste which cannot be removed by nasal washes. The discharge comes from one naris only, and is usually intermittent, occurring only in certain positions of the head. On inspection the pus may sometimes be seen entering the naris in the middle meatus. Tenderness may be elicited on palpation over the malar prominence on the affected side, and there may be marked redness of the gum corresponding to the side affected.

The disease may be mistaken for ozæna, disease of the frontal sinuses or of the ethmoidal cells, or for tumors, cystic growths, and foreign bodies in the antrum. Pus in the antrum may be detected by

FIG. 310.



Ingals' Electric Lamp for Transillumination (one-half size).

injecting peroxide of hydrogen through the normal opening, when, if pus be present, a discharge of froth will take place. Transillumination often aids in a correct diagnosis. A small lamp (Fig. 310) placed in the mouth of the patient in a dark room will cause a rosy illumination of the cheeks, lips, and lower eyelid on the healthy side. But if the antrum is filled with pus, the cheek and lower lid will remain dark. If the room cannot be darkened, a photographer's focusing cloth thrown over the heads of both patient and physician will exclude the external light sufficiently. Dr. Henry Ohls of Chicago has described a new method of transillumination by an ordinary cautery electrode, protected by a two-drachm vial (Fig. 311). This "home-

FIG. 311.



Dr. Ohls' Lamp for Transillumination.

made" lamp can be used in connection with any cautery battery. Care must be taken not to leave the current on too long at a time, for fear of burning out the electrode. Solid tumors and foreign bodies would

also render the affected side opaque, while cysts light up more distinctly than the healthy cheek.

Cases are apt to be prolonged even under the most approved surgical measures.

**Treatment.**—When pus has formed, a free opening for its evacuation is usually necessary, although some cases have been cured by irrigation through the natural passages with pyrozone or other antiseptic solutions, applied with the long-nozzled syringe. This treatment, however, is usually difficult and unsatisfactory.

The antrum may be opened through the nose, through a tooth-socket, or through the anterior wall above the alveolus. Probably the best results are obtained by the opening through the tooth-socket. This can be accomplished by trephines or drills. The Brainaid conical bone-drill is a favorite (Fig. 312). The opening thus made will close in a

FIG. 312.



Brainaid's Bone-drill.

few weeks unless kept free by some form of drainage-tube, as, for example, that illustrated in Fig. 313. Subsequently the cavities must be kept clean by irrigation with antiseptic solutions.

FIG. 313.



Ingals' Drainage-tube for Antrum (full diameter; three different lengths).

Various stimulating solutions or powders will also be needed, and care in plugging the opening before eating must be taken to prevent entrance of particles of food.

### DISEASE OF THE SINUSES.

**EMPHYEMA** of the sphenoidal sinuses is a rare affection, and when found is very difficult to treat successfully. It usually causes severe headache, and is accompanied by a discharge of pus, which generally escapes through the naso-pharynx instead of the nostrils. The senses of smell and sight may be more or less disturbed. The abscess may open spontaneously, and, if not, the sinuses should be perforated and treated by irrigation, as in empyema of the antrum.

Inflammation of the frontal sinus may be acute or chronic. The acute form is the result of extension from the nasal mucosa or adjacent bone, or of direct infection through a wound. The chronic form is usually due to syphilis or tuberculosis. The chief features are pain and headache, a sense of weight and fulness in the forehead, with,



usually, coryza. There are swelling, tenderness, more or less fever, rigors, and may be delirium. The situation of the duct of the sinus usually allows the escape of the inflammatory products, and in simple catarrhal cases a spontaneous cure results; but when swelling obstructs the duct the secretions distend the sinus and produce severe symptoms. The application of cocaine three or four times a day may reduce the swelling and allow the escape of the secretion, so that a cure follows.

The contents of the sinus may undergo suppuration, causing empyema, and possibly demanding surgical interference. When the orifice of the infundibulum can be found the sinus may be washed out daily, or two or three times a week, with a warm solution of boric acid (gr. xv) and hydrogen peroxide (5ij) in enough water to make an ounce, by means of a syringe with a long silver nozzle like that shown for anæsthetizing nasal mucous polypi. The sinus may be opened from the nasal cavity by a small drill, or from the external surface by trephine or chisel, the object being to institute thorough drainage of the cavity. Subsequent irrigation and stimulation are to be used as in suppuration of the other sinuses.

#### DISEASE OF THE ETHMOID CELLS.

INFLAMMATION of the ethmoid cells usually causes severe neuralgic pains over the orbit and a muco-purulent discharge, generally from one side of the nose. Not infrequently small polypoid growths are associated with the ethmoid disease.

**Treatment.**—The object of the treatment should be to remove any obstruction to the free exit of pus and to render the parts as clean and aseptic as possible. The cells may be cleansed by injecting boric-acid solutions, pyrozone, or other antiseptics. The patient may advantageously use at home a stimulating antiseptic spray consisting of thymol gr.  $\frac{1}{3}$ , oil of cloves ℥ v, terebene ℥ x, to the ounce of liquid albolene. Washing the nose twice daily with an alkaline solution, as, for example, the Rhodes tablets, assists greatly in keeping the parts clean. But even with the most persistent treatment the disease may last many months or even years, but a few cases seem to recover spontaneously.

#### RHINO-PHARYNGITIS.

RHINO-PHARYNGITIS, commonly called post-nasal catarrh, is usually a chronic affection resulting from nasal obstruction. It is most frequent in a cold, moist climate, and is sometimes excited by a dusty atmosphere. Excessive smoking, drinking, and breathing bad air also produce the affection.



An examination with the rhinoscope discloses the presence of tenacious secretion coming down back of the soft palate, a collection of muco-pus in the naso-pharynx, or firmly adherent dry crusts extending from the pharynx up into the naso-pharynx. The mucous membrane usually appears congested. The posterior ends of the turbinated bodies may be enlarged or the mucous membrane at the sides of the vomer thickened. The orifices of the Eustachian tubes may be either swollen, congested, or occluded by secretion. There is a frequent desire to hawk and clear the throat of the viscid secretion, especially in the morning and after eating, the effort in many cases causing nausea or even vomiting. There are often a sense of dryness in the throat and offensive breath from decomposing secretions, and the hearing is often obtunded.

**Treatment.**—Many mild cases never apply for treatment. Well-developed cases require a great deal of patience on the part of both patient and physician. Direct causes, as nasal obstruction, adenoids, and the like, are to be removed. Exciting causes, as exposure and bad, unhygienic surroundings, must be avoided. The digestive organs must be kept in a healthy condition, and constitutional treatment is to be instituted if indicated. Locally, cleanliness of the nares and naso-pharynx is to be sought after. Gargles are seldom of much use, but sprays and washes are serviceable. Washing by snuffing the solution through the nose from the palm of the hand or by means of nasal or post-nasal syringes (Fig. 314) is efficacious in removing the secretions

FIG. 314.



Post-nasal Syringe (two-fifths size).

and preparing the parts for local applications. While using the wash the patient should keep his mouth open and should be careful not to swallow. He must also use very little force, so that the fluid will not pass into the Eustachian tubes. The solution should be applied lukewarm. Dobell's solution or a simple alkaline preparation of equal parts of sodium bicarbonate and sodium chloride, 1 drachm of the mixture to the pint of water, may be used, or Rhodes' tablets may be employed. After cleansing, astringent or stimulating powders are of much service. Much benefit is derived from the occasional use of a powder containing 1 part of berberine muriate to 1 or 2 of acacia. This should be gently forced through the bent tube of the insufflator up back of the palate, so as to cover the vault of the pharynx and lodge in the naso-pharynx, the patient being instructed to retain the powder as long as possible.

Some authorities recommend painting the surface with strong solutions, such as silver nitrate, 5 to 10 per cent., or tincture of iodine, about half strength.

For relief of the dry sensation an oily spray containing carbolic acid, from 2 to 5 grains, and menthol 1 to 2 grains to the ounce of liquid albolene, gives good results when applied to the diseased surface.

#### THROAT DEAFNESS.

Diseases of the nares and naso-pharynx often involve the Eustachian tubes and extend to the middle ear, thus causing most of the cases of deafness. Whatever causes obstruction to the Eustachian orifice or canal may induce rarefaction of the air in the tympanic cavity, and if long continued will cause depression, with inflammation and thickening, of the membrana tympani, and consequently more or less complete deafness. The patient usually complains of a sense of fulness in the ears and of rumbling, roaring, and buzzing sounds. Sometimes, if the deafness is due to obstruction at the Eustachian orifice, it will subside, or may be cured by mildly astringent or stimulating applications, like those already recommended for rhino-pharyngitis; but when much thickening of the lining membrane of the tube has taken place, with consequent changes in the middle ear, as in most cases of long standing, we may be well satisfied to check the progress of the disease and prevent an increase in deafness.

**Treatment.**—First find the cause, if possible, and if due to nasal or pharyngeal obstruction, such as caused by exostoses, tumors, adenoids, or the like, it should be removed by the methods recommended under their respective headings, and post-nasal catarrh must receive its appropriate treatment. When this does not suffice, direct treatment to the Eustachian tube is employed. It may be necessary to supply the drum-cavity with fresh air by means of Politzer's method, or, if the catarrhal inflammation has extended to the tympanic cavity, remedies may be introduced into the tympanic chamber by the Eustachian catheter, or by medicated oleaginous sprays thrown up behind the palate with an atomizer having a long bent tip, the nostrils and mouth being closed at the time, or thrown through one nostril, all escape at the nostrils being prevented, as in using the Politzer bag. The treatment is taken up more in detail under Diseases of the Ear.

#### RETRO-NASAL FIBROUS TUMORS.

Polypi as they appear in the naso-pharynx usually originate from the periosteum, and may be almost entirely fibrous. The more fibrous in structure the more vascular they are. They may attain very large size, and produce great disfigurement, known as frog-face. The affection is rare, and occurs usually in children and young adults, the



tendency to this growth usually disappearing by about the twenty-fifth year. These tumors cause nasal obstruction and frequent epistaxis, and appropriate treatment necessarily depends upon a correct diagnosis.

**Treatment.**—Fibrous tumors should be removed through the nares or naso-pharynx, if possible, by means of the cold-wire snare, galvano-cautery snare, or by electrolysis. On account of the firmness of the tissue and its vascularity, the galvano-cautery écraseur is preferred. When the tumor is of large size the operation assumes grave aspects and presents many difficulties, but in experienced hands the life of the patient is safer with the operation than without it. Medical applications to the surface are of very little value, excepting as detergents, and the author has seen one case where weak solutions of carbolic acid repeatedly caused hæmorrhage, apparently due to the carbolic acid, as other solutions did not have this effect. Injections of lactic acid, strength 20 to 35 per cent., with carbolic acid, 3 to 5 per cent., in water, preceded by a little cocaine, has proven very beneficial in reducing the size of the tumor and preventing recurrence after its removal.

#### **HYPERTROPHY OF THE PHARYNGEAL OR LUSCHKA'S TONSIL (ALSO KNOWN AS ADENOID GROWTHS).**

This condition consists of an abnormal enlargement of the glandular tissues normally found in the vault and walls of the pharynx. The hypertrophied tissue appears quite evenly distributed across the vault of the pharynx, and consists of increased connective tissue and lymphoid structure, such as is found in hypertrophied faucial tonsils. The new growth may be quite firm, but is usually soft and friable.

Upon examination of the naso-pharynx with the rhinoscope nodular or pendulous masses of a gray or pinkish color, with a smooth surface, are detected. In young or unmanageable children it may be necessary to palpate the naso-pharynx before an accurate diagnosis can be made.

**Treatment.**—In a great percentage of these cases the enlarged glands, untreated, would atrophy at about the age of puberty. But it must not be forgotten that a great deal of permanent damage may result in the mean time to the general health, the hearing, and voice. In fact, the advice which some physicians give to allow the child to outgrow the difficulty has been characterized as criminal. Removal of the diseased tissue is advised in order to improve the general health, mental development, and formation of the face and chest; to prevent inflammation of the Eustachian tube and middle ear; to prevent permanent alteration in the voice and increased danger from zymotic



diseases. Even when of long duration, removal of the disease results very, if not most, satisfactorily.

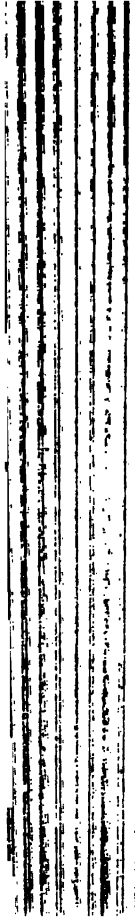
As pointed out by the author in the *Journal of the American Medical Association* in 1894, "it is not uncommon for young children to gain within six months after the operation from 20 to 40 per cent. in weight, and correspondingly in vigor and endurance."

Where opposition is raised to an operation, or when for other reasons operation is impracticable, some benefit may be derived from the administration of the syrup of the iodide of iron. Calcium chloride also might cause in some cases reduction of the hypertrophied tissue. Local astringents have proved of some benefit in a few cases.

Successful results are obtained by the use of chromic acid. The applications are made by fusing a few crystals of this caustic on the end of a flat aluminum probe, and passing it through the nostril and into the pharyngeal tonsil, where it is held a few seconds. The soreness which follows for several hours is not severe. The treatment is to be repeated every four or five days until the growth disappears.

For the direct removal of the growth several methods may be employed. Many operators scrape the gland away by means of a long finger-nail or a sharp curette. The galvano-cautery, with a bent electrode, is used by others, but is painful and rather unsatisfactory. Probably the most satisfactory instrument for this purpose is Lowenberg's forceps, or, better, John N. Mackenzie's modification of this instrument. In adults local anæsthesia by cocaine is usually a sufficient preparation for the operation, but in children chloroform anæsthesia is advised; in fact, a general anæsthetic is held necessary for a thorough removal of the growth. The final result, as stated above, is most satisfactory to the physician and friends of the patient.

The subsequent treatment should consist of mild antiseptic sprays and powders thrown through the nares. Those recommended after cauterization of the turbinated bodies answer an excellent purpose.



## DISEASES OF THE UVULA, THE PHARYNX AND LARYNX.

By D. BRADEN KYLE, M. D.

### DISEASES OF THE UVULA.

DISEASES of the uvula without involvement of surrounding structure are of rare occurrence. There are, however, a few localized pathological conditions which demand at least brief notice.

#### ELONGATION OF THE UVULA.

Elongation may occur from a number of causes. In anæmic individuals, from general weakness, causing loss of muscular tone, there may be relaxation of the uvula giving rise to all the symptoms of elongation. In such cases general treatment should be instituted for the relief of the anæmia and for the improvement of the muscular tone. Should the symptoms produced be of sufficient severity, such as persistent irritating cough, asthmatic or choking attacks, or spasm of the glottis, demanding immediate relief, the application of strong astringents, such as nitrate of silver, 10 to 15 per cent. solution, or 10 to 20 per cent. chromic acid, every second or third day will give temporary relief. No local applications regardless of the cause will give permanent relief. The best results can be obtained by the forcible pinching of the tip of the uvula by means of ordinary forceps, or by the use of the hæmostatic forceps, being careful not to compress the tissue sufficiently to cause devitalization. When elongation occurs from involvement of structure in the naso-pharynx, causing depression of the soft palate, thereby forcing the uvula down, the treatment should be directed to the offending structures and not to the uvula; the same is true where relaxation is due to partial paralysis following scarlet fever, diphtheria, and allied conditions. The common cause of permanent elongation is continued catarrhal inflammation of the posterior nasal cavity and naso-pharynx, causing not only elongation, but chronic thickening. Treatment should be instituted for the relief of the catarrhal condition, and, if the elongation is sufficient to produce pharyngeal irritation and constant hacking cough, relief can often be obtained by the compression method given



above, the pressure being sufficient to set up considerable inflammatory process with subsequent organization and contraction. Should this procedure fail, the removal of a portion of the tip of the uvula is necessitated.

For this operation a number of special instruments have been devised and various methods suggested. These instruments are all no doubt useful, the objection to them being that they necessitate a straight cut, the portion removed leaving the entire tip denuded of epithelium with a flat scar resulting. If the uvula be rendered insensible by the application of a 3 to 5 per cent. solution of cocaine and the tip grasped firmly with a pair of ordinary straight forceps, care being taken to exert little or no traction, a wedge-shaped portion with the point of the wedge up (the portion removed depending, of course, on the extent of elongation), can be removed by means of a small sharp bistoury—the advantages of this procedure being that the two flaps thus formed close together, leaving a mere line of scar and yet forming a long line for contraction, also that the lateral flaps protect the cut surface. This method requires no special instrument and in my own experience has been highly satisfactory. Care should be taken not to remove too much of the tissue. After the removal of the portion of the uvula, the parts should be sprayed every three hours with an antiseptic alkaline solution such as—

R̄. Sodii bicarbonatis,	gr. viij (0.5);
Acidi carbolici,	gtt. iv (0.25);
Glycerini,	℥ xv (1.0);
Aquæ,	q. s. ad f̄j (30.0).—M.

The patient should be directed to take no irritating foods for twenty-four to forty-eight hours. No irritating condiments should be used.

**Hæmorrhage after Uvulotomy.**—Usually the simple operation of uvulotomy is not attended by any serious results, the hæmorrhage occurring being only slight. When hæmorrhage does occur it is usually of such severity that the ordinary hæmostatics are of no avail. The simplest method for the arrest of the hæmorrhage is to use the ordinary needle-holder carrying a curved needle, threaded with double silk thread, having the ends of sufficient length to permit of tying outside the mouth. The needle should be passed through the uvula laterally just above the cut surface and each thread tightened sufficiently to arrest the bleeding.

#### ULCERATION OF THE UVULA.

Ulceration of the uvula is usually associated with ulceration of the adjacent structure, occurring in syphilitic and tubercular condi-

tions or in any of the specific inflammatory processes. In such cases the treatment should consist of local cleansing of the parts by means of hydrogen peroxide, followed by an alkaline antiseptic wash such as boric-acid solution, 10 grains to the ounce, or the following :

R <sub>x</sub> . Sodii biboratis,	
Sodii bicarbonatis,	āā. gr. viij (0.5);
Acidi carbolici, vel	
Toluol,	gtt. j vel v (0.05-0.3);
Glycerini,	gtt. xv (1.0);
Aquæ,	q. s. ad f̄j (30.0).—M.

Also the administration of constitutional treatment as indicated in the articles devoted to the treatment of those special diseases. Ulceration following catarrhal processes should be treated by the same cleansing method, the surface dried, and then some stimulating powder should be applied. The stearate of zinc, containing salicylic or boric acid 30 to 60 grains to the ounce, should be used. The catarrhal ulcers are usually situated on the posterior part of the uvula and are often overlooked, therefore a careful rhinoscopic examination should be made.

#### ACUTE UVULITIS (ŒDEMA OF THE UVULA).

As a rule, the sudden inflammatory process involving the uvula and producing œdema also involves the pharyngeal structure, but from localized irritation or trauma it may be limited to the uvula alone. It suddenly becomes swollen, boggy, and sacculated, producing a constant pharyngeal irritation and consequent cough, and causes pain on swallowing, especially when taking food. The uvula may become so enlarged as to almost entirely cover the pharyngeal wall. When the process is rapid, causing sudden œdema, the surface should be coated over with a 10 per cent. solution of cocaine and the œdematous tissue filled with multiple punctures by means of a sharp-pointed bistoury, or, better, the double-cutting aspirating needle. During the puncturing, protection should be afforded the pharyngeal wall by placing back of the uvula some solid body; the short curve of an ordinary double retractor answers very well. After the puncturing the tissue should be thoroughly cleansed and coated over with some mild astringent such as tannin, 3 to 5 per cent. solution, or a weak solution of sulphate of copper, 1 to 3 grains to the ounce. Splendid results may be obtained by spraying the parts, after the puncturing, with ice-water.

**CHRONIC UVULITIS.**

Chronic uvulitis is almost universally found associated with chronic pharyngitis or naso-pharyngitis, and is dependent almost entirely upon an intensification of the causes underlying these processes.

The treatment should be directed to the associated condition.

**TUMORS OF THE UVULA.**

Tumors of the uvula proper and not involving the adjacent structures are rare. Occasionally it may be the site of single or multiple papilloma. The tumor should be removed by means of the biting forceps, being careful to produce as little laceration of structure as possible, the necessary wound being treated by a cleansing alkaline solution.

**BIFID UVULA.**

This condition exists quite frequently, and although in itself it is strictly a malformation and not a diseased process, yet it may, owing to its shape, extent, and faulty action, give rise to tickling of the pharynx, followed by an irritating, hacking cough. Instead of removing one portion of the uvula, the inner surfaces of the two portions should be denuded, permitting the contact of the two granulating surfaces, and thereby forming complete union. If there has been slight elongation, the contraction following the scar-tissue formation will be sufficient to correct it without the removal of any structure.

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**DISEASES OF THE PHARYNX.****ACUTE PHARYNGITIS.**

AN acute inflammatory process involving only the pharyngeal wall may occur, but as a rule there is involvement of adjacent structures; even in less severe cases the posterior pillars are involved, while in severe cases the anterior and posterior pillars, the uvula, tonsil, and peritonsillar tissue are implicated.

The lesion may be due purely to a local irritation or may be a local manifestation of some constitutional condition, or may be associated with or occur as a sequel of the latter. The symptoms produced, regardless of cause, are very much the same, and plans of rational treatment are naturally based on the etiological factors, either primary or secondary. First, then, treatment for the immediate relief of the distressing symptoms; and, second, the appropriate treatment for such conditions, constitutional or local, which may



give rise to attacks of acute pharyngitis. For example, the attack may be due to intestinal or gastric irritation, or to a gouty or rheumatic diathesis; the general treatment, therefore, should be directed to the relief of the underlying cause. It must also be remembered that acute pharyngitis is frequently associated with, or really a continuation of, an acute inflammatory process of the post-nasal cavity. In such cases the treatment should be directed more to the naso-pharynx than to the pharynx proper. In the treatment of an acute inflammatory process of the pharynx it should also be borne in mind that for the performance of physiological function the tissue is richly supplied with blood-vessels and epithelial cells, and that after desquamation the surface epithelium is rapidly reproduced from its dense genetic layer. Besides the conditions mentioned above as etiological factors it must be remembered that the administration of certain drugs that are eliminated by the mucous membrane may be the cause of the inflammatory process. Of such drugs the iodine, bromine, and phosphorus preparations may be named. Their prompt withdrawal is usually the only treatment necessary.

When the inflammation is limited to the pharynx the remedial agents should and can be applied directly to the part; this can be done in a number of ways: by means of gargles, sprays, the direct application by means of cotton and applicator, or in the form of lozenges. If the patient is seen in the early or first stage of the inflammatory process, the treatment indicated is vastly different from that demanded when it has reached the second or exudative stage. It must be remembered that in the first stage the pathological alteration is not a structural one, but is entirely limited to the vessels; that the mucous membrane has its normal lubricating secretion, which is furnished by the mucous glands located in the submucosa; that in the first stage, or stage of engorgement, the pressure exerted by the now over-distended arterioles and capillaries cuts off this normal secretion by the temporary occlusion of the excretory ducts, and therefore the surface will be dry and irritated. The object of treatment in this stage should be depletion and the rapid relief of the vascular engorgement. To accomplish this the same principles that are applicable to any other localized inflammatory process should be employed here. The local or constitutional application of such agents as cause relaxation of tissue will bring about depletion, if not more rapidly, at least more in accordance with Nature's process, than by the application of astringents or remedies which contract the tissue. While it is possible to relieve the engorgement and cause contraction of the vessel, and even re-establish circulation and secretion in local spots of inflammation, yet the irritation produced by the application of such remedial agents to

the delicate mucous-membrane surface may augment the very condition you are aiming to relieve. Instead, then, of the application of such solutions as iodine, nitrate of silver, etc., there should be administered locally and internally such drugs as pilocarpine, apomorphine, ipecac, tartrate of antimony, and other drugs in the same line. These should be administered in small and frequently repeated doses. An effervescent tablet containing  $\frac{1}{100}$  of a grain of pilocarpine allowed to dissolve slowly in the mouth and repeated every hour for three or four doses will usually give relief.

The administration of drugs which act on the vasomotor system causing contraction of the vessel-wall may give the desired result and is preferable to the local application of any irritating agent. If the inflammatory process be localized, astringents may be used with good results, but if the process involves the entire pharyngeal surface they should not be used. If the throat is irritable or the raw feeling is present of which the patient so frequently complains, local sedatives should be used. The parts should be sprayed with a bland oil containing three drops of oil of sandalwood to the ounce, the oil of sandalwood being decidedly sedative to the mucous membrane and the bland oil serving the double purpose of a lubricant and a protector. To some patients the oily preparations are decidedly disagreeable; in such cases the surface may be sprayed with a weak cocaine solution not stronger than 2 or 3 per cent., the object being more to relieve the irritation than to cause contraction of the vessels. When menthol is used for the relief of this condition it should not exceed two grains to the ounce. If used in combination with camphor, much better results are obtained. The following usually gives relief:

R. Camphoræ,	gr. ij (0.10);
Menthol. (crystal.),	gr. ij (0.10);
Olei santali,	gtt. iv (0.2);
Alboleni (liquid.),	f℥j (30.0).—M.

Should the severity of the symptoms demand internal medication we have in codeine in small doses the best remedial agent. When the pharyngitis is not dependent upon purely local conditions, but is caused by gastro-intestinal or hepatic disturbances, immediate attention should be given to the gastro-intestinal tract. A purgative should be given, followed by a saline; such as the administration of one to three grains of calomel to one grain of compound colocynth powder, followed by a saline that will stimulate glandular secretion. This can be accomplished by the administration of two to four drachms of the granular effervescent phosphate of sodium, which may be repeated three times daily.



In the second or exudative stage, where the vessels and glands have relieved themselves of engorgement, very little medication is required. If the secretions are profuse and tenacious, the membrane should be cleansed with a simple alkaline wash. If the inflammation is localized, due to any of the above causes, and does not involve the entire pharyngeal surface, astringents may be used. Such solutions as 3 per cent. chloride of zinc, alum, 5 to 10 grains to the ounce, or chlorate of potash, 10 to 15 grains to the ounce, should be applied by means of sprays, or, better, by means of cotton and an applicator. When the inflammation is localized to the margins of the pharyngeal wall, which is often the case if dependent upon gastro-intestinal irritation, relief can be obtained by the use of a mild astringent such as the compound tincture of benzoin with equal parts of 50 per cent. boro-glyceride. Should the second stage not pass rapidly on into resolution, the hypersecretion and elaboration of mucus can be controlled by the administration of minute doses of belladonna in the form of atropine, or aconite in the form of aconitine—of either, the  $\frac{1}{300}$  to  $\frac{1}{400}$  of a grain—not repeated oftener than every three or four hours and only to the point of beginning physiological effects. These drugs apparently have a specific action on the faucial circulation. It is not necessary to confine the patient to his room unless the severity of the local condition leads to threatening constitutional symptoms.

#### SIMPLE CHRONIC PHARYNGITIS.

Chronic pharyngitis is usually a secondary condition, not secondary to repeated attacks of acute inflammation, but associated with, or dependent upon, pathological lesions elsewhere, such as chronic nasopharyngitis, gastro-intestinal irritation; cardiac, hepatic, or renal changes; also such conditions, as rheumatism and gout, where, by the presence in the blood and secretions of uric acid, and by its elimination from the mucous-membrane surface, there is established a slow chronic inflammatory process with increase in the connective-tissue elements. Generally in valvular lesions of the heart, especially mitral disease, there is a slowed venous circulation; in such cases there is a cyanotic condition produced in the mucous-membrane surfaces, especially those surfaces which are surrounded or backed up by bony or cartilaginous wall; this is especially noted in the mucous membrane of the pharynx as well as in the continuous and contiguous structures. When due to obstructed circulation the thickening produced is entirely within and dependent upon the over-distended vessels, and thus the real condition existing in the tissue is that of a pressure-atrophy. This same condition may be produced by lesions of the kidney and liver in which, from fibrous contraction due to interstitial inflammatory processes, there is interference with the general cir-



culatation and secondary cyanosis of mucous membrane. These important points must not be overlooked, as curative treatment and accurate prognosis depend entirely upon their recognition.

As this condition is largely a secondary one the treatment should be directed toward the underlying etiological factor, as local treatment will be only palliative until the active cause has been removed. It would be impossible in this article to outline plans of treatment for the many underlying causes. For the relief of the local irritation and diminished secretion which are influenced by atmospheric change, stimulating solutions should be used. In the essential oils we have possibly the best remedial agents. The topical application by means of cotton and probe of the following I find to give the most relief:

R.	Ol. picis liquidæ,	gtt. x-xx (0.65-1.3);
	Ol. olivæ,	f 3j (30.0).—M.
Or,		
R.	Ol. pini sylvestr.,	gtt. x-xx (0.65-1.3);
	Ol. eucalypti,	gtt. v-x (0.3-0.65);
	Alboleni (liquid.),	f 3j (30.0).—M.

Stimulating action may be increased by adding to the above 1 grain of menthol. This will increase normal secretion, lessen the dryness and by so doing lessen the tendency to accumulation on the surface and thereby liability of lodgment of bacteria. If the alteration in the tissue be truly chronic, with the formation in the submucosa of new connective-tissue elements leaving permanent thickening, or from the over-distended vessels in cyanotic conditions, with subsequent atrophic changes in the epithelial and connective-tissue structures, a permanent cure cannot be effected. Should the patient be addicted to the use of tobacco, especially excessive smoking, its use should be prohibited.

#### FOLLICULAR PHARYNGITIS.

This condition is limited strictly to the pharyngeal mucous membrane and is an involvement of the muciparous glands and surrounding lymphatic structure; it occurs more frequently in individuals of a lymphatic temperament and a highly nervous organization. It may occur at almost any age, the most aggravated form occurring in individuals whose occupation requires continued use of the voice, and it is seen in what is called "clergyman's sore throat." Besides the number of small round nodules there are also present in the mucous membrane engorged and over-distended vessels. The treatment should be, first, the careful attention to the general health of the patient, and second, the local treatment of the follicles and engorged

vessels. The patient's general condition should be improved by the administration of such tonic agents as the various preparations of iron, nux vomica, cod-liver oil, hypophosphites, etc. The constitutional treatment must depend entirely on the clinical indications presented by the patient, and must be determined by the practitioner. In the early or acute stage where permanent structure-change has not taken place I have obtained excellent results from the administration of drugs which are eliminated by the mucous membrane. The following should be administered three times daily :

Ry. Phosphori,	gr. $\frac{1}{1000}$ (0.0006);
Iodini,	gr. $\frac{1}{8}-\frac{1}{6}$ (0.008-0.001);
Bromini,	gr. $\frac{1}{8}-\frac{1}{6}$ (0.008-0.001);
Vini Xerici,	ʒj (4.0).—M.

The distressing cough and constant irritation can be relieved by the administration of codeine, in doses of one-twelfth to one-eighth of a grain, three or four times daily. As to the treatment of the actual follicle, the application of the galvano-cautery should be the last resort, as its use necessitates the destruction not only of the follicle but also some of the healthy surrounding structure, with subsequent fibrous-tissue formation, whilst the contraction is marked when due to burns, and the application of the galvano-cautery practically amounts to a burn. Each follicle may be touched with a 20 per cent. chromic acid solution, or the dilute hydrochloric acid. This can be done without contact to the surrounding structure if a fine-pointed applicator is used on the point of which is tightly wrapped a small portion of absorbent cotton; the cotton is saturated with the solution and the excess dried off with another piece of cotton and then applied directly to the follicle, using very little pressure. In more obstinate cases the simple puncturing of the follicle by means of a sharp-pointed applicator or probe is sufficient. Relief of the engorged vessels may be obtained in the same way. Should the condition be chronic with fixed tissue alteration, the application of the galvano-cautery is warranted. The needle should be fine-pointed and heated to a white heat and should be applied direct to the follicle, care being taken not to penetrate too deeply into the tissue and not to involve the healthy surrounding structure. I have seen cases in which a great number of follicles have been removed by the galvano-cautery several years previous, in which the condition of the pharynx, brought about by the extensive and possibly careless cauterization, was much worse than that originally produced by the follicular pharyngitis. When follicular pharyngitis is associated with naso-pharyngeal catarrh, treatment for the associated condition should be instituted.

**DRY OR ATROPHIC PHARYNGITIS (PHARYNGITIS SICCA).**

Dry pharyngitis is usually spoken of as a chronic inflammatory process. It is in reality not an inflammatory process, but a pathological alteration produced in the mucous membrane secondary to such processes, and necessarily involves a number of causative elements. It may follow chronic pharyngitis, either simple or follicular, where, from fibroid-tissue formation in the submucosa, the vascular supply being diminished, there is subsequent atrophy. This contraction involves the submucosa and the muciparous glands, as well as the epithelial layer. Upon the amount of fibrous tissue and the alteration produced in the structure involved in the contraction, as well as the extent of the area involved, will depend the prognosis as to palliation or cure; for, if the process is well advanced, no amount of local or constitutional treatment will alter the already formed fibrous tissue or arrest its contraction. The process may be limited to the pharynx, or it may be subsequent to the same condition pre-existing in the anterior nasal cavity and naso-pharynx; when such is the case, the morbid process involving the true pharyngeal surface is somewhat different and is more amenable to treatment than when secondary to localized inflammatory conditions of the pharynx. This is true for the following reasons: The condition is brought about by mechanical irritation, instead of by spreading by continuity of tissue from the nasal mucous membrane. With atrophy of the mucous membrane of the nasal cavities there is marked enlargement of the space for transmission of air; this allows an increased volume of air to pass through the nasal cavities. Owing to the altered condition of the membrane, even the normal amount of air would not be physiologically altered in temperature and moisture, much less the increased volume. This in itself would act as an irritation to the pharyngeal wall. The ciliated epithelium has also lost its function owing to the atrophic process of the nasal mucous membrane; therefore the particles of dust carried in by the air, instead of lodging and being expelled, pass directly into the naso-pharynx and pharynx. Still another source of irritation is the lodgment in the naso-pharynx of the altered secretion, together with its infection by saprophytic bacteria. The fact that such cases are more amenable to treatment does not depend so much upon the structural alteration of the tissue as it does upon the fact that the pre-existing condition in the anterior nares and naso-pharynx directs attention to the pharynx proper, and treatment can be instituted early.

The varieties of dry pharyngitis due to other causes present the same appearance clinically, but differ very much in their structural alteration. For instance, in dry pharyngitis due to certain fumes or vapors the change is limited, at least for some considerable time, to



the epithelial layer, and the discontinuance of exposure to such fumes will usually promote a rapid recovery. The variety seen in diabetes mellitus also presents very little structural change and requires no separate treatment other than that indicated in the article on that special disease. A mild variety of dry pharyngitis may be induced by nasal obstruction causing mouth-breathing. The treatment is obvious: remove the nasal obstruction. If this should be done early, before any structural change has taken place in the pharyngeal tissue, the irritated membrane will rapidly return to normal, but should the obstruction be of long standing, the condition of the pharyngeal tissue will be that induced by any chronic inflammatory process. Irrespective of cause the appearance presented by the mucous membrane is the same. The surface is dry and wrinkled and has the appearance of having been coated over with a thin layer of varnish. Localized masses of thick, tenacious secretion of a greenish or brownish color are frequently present; this gives rise to the sensation of a foreign body in the throat, causing cough and continual effort at expulsion.

It has been my own experience that solutions used by the patient rarely cleanse the membrane. While the patient should be given a solution for this purpose to use two or three times daily, to ensure perfect cleansing he should be seen by the attending physician at least every other day, or better daily, and the dried secretion be thoroughly removed, preferably by swabbing the entire surface with hydrogen peroxide and water equal parts, followed by an alkaline wash such as—

R. Sodii bicarbonatis,  
Sodii biboratis,  
Sodii chloratis,  
Potassii bicarbonatis,      *ââ*. gr. xv (1.0);  
Aquæ,      f 3ij (60.0).—M.

This solution should be as hot as can be borne by the patient. This should be followed by a gargle of equal parts of hydrogen peroxide, aqueous extract of hamamelis, and cinnamon water. The membrane should be thoroughly dried by pledgets of absorbent cotton carefully mopped over the surface and a mild stimulating solution applied. Better results will be obtained by the direct application of such solutions than when applied by sprays. For the local stimulation one-half to one drop of oil of mustard to an ounce of albolene or liquid vaseline, applied every other day directly to the diseased surface, is the best agent. Equally good results can be obtained by using, after cleansing and drying the membrane, pledgets of cotton saturated with an ointment of ichthyol and lanolin equal parts, the pledgets being far back in the nostril from fifteen to thirty minutes or until there is marked stimulation of the membrane.

The object of such applications is to produce merely a hyperemia of the vessels, and care must be taken not to set up too violent irritation or the resulting inflammatory condition will entirely offset the benefits of stimulation. Even after the most thorough cleansing of the membrane there is a tendency to the rapid accumulation of the altered secretion, and for the relief of the distressing symptoms caused by this accumulation there should be prescribed for the patient an oily preparation which not only lubricates the parts, but also softens the secretion. The following formula will produce the desired effect:

R. Menthol,	gr. v-x (0.3-0.65);
Alboleni, vel	
Vaselini (liquid.),	f 3j (30.0).—M.

The special constitutional treatment should consist in the administration of drugs which directly affect glandular secretion and are at least partially eliminated by the mucous membranes. In the general treatment, beside such agents as are administered for direct effect on the diseased area, it is well to give some drug that will ensure the regular and free movement of the bowels, not so much by its purgative action as by its stimulation of glandular secretion. For this purpose the phosphate of soda should be given in from 2- to 4-drachm doses in the form of the granular effervescent powder, twice or thrice daily, the frequency and size of the dose depending upon the therapeutic effect and the clinical indications. The iodides, in the form of iodide of potassium and sodium, from their therapeutic action on glandular secretion are unquestionably indicated and beneficial, but as the condition requires their continued use they are generally followed by the gastric irritation which the long-continued use of these drugs produces.

The arsenical preparations, however, are equally efficacious, and owing to their lessened tendency to produce gastric irritation are preferable. The best results will be obtained by the administration of from gr.  $\frac{1}{24}$  to  $\frac{1}{16}$  of the double sulphide of arsenic given in pill-form three times daily after meals. Besides the special treatment given appropriate remedies administered for the improvement of the general condition will aid materially in the successful treatment.

#### INFECTIVE PHARYNGITIS.

This condition is somewhat similar to true diphtheria of the pharynx. The infecting bacteria are the streptococci, although there are frequently associated germs. It is usually sudden in its onset, and the pain, fever, and difficulty in swallowing—in fact, all symptoms—are out of proportion in severity to the appearance of the localized lesion. The small white patches which appear on

the tonsils and pharynx are areas of liquefaction and coagulation-necrosis.

The treatment should consist at first in the thorough purgation secured by the administration of minute doses of calomel ( $\frac{1}{10}$  grain) and soda (1 grain) every half hour for ten doses, followed by a saline. The spots should be thoroughly mopped with Löffler's solution. This should be repeated from one to three times daily until the tendency to ulceration disappears. The patient should be instructed to use every two hours a gargle, as follows :

R. Extracti hamamelidis (aqueous),  
 Aquæ cinnamomi,  
 Hydrogenii peroxidi,      *aa.* f̄3j (30.0);  
 Chloral hydrate,              gr. vj (0.4).

Sig.—Dilute in equal parts of water and use as a gargle every two hours.

#### ACUTE RHEUMATIC PHARYNGITIS.

The uric-acid diathesis manifests itself systemically and locally in a number of forms. In any variety there is produced in the secreting or glandular structures a certain amount of irritation due to the presence of the uric acid. This is due to the fact that when an excess of elimination is demanded by the excretory organ the necessity of the elimination is beyond the power of the function of that organ; and other secreting surfaces, such as the skin and the mucous membranes, aid as eliminators. The exciting factor of an attack is usually exposure to cold and dampness, especially if associated with any lessened vitality of the individual. The attack, as a rule, comes on suddenly.

**Treatment.**—The daily habits of the individual should be carefully studied; if they are sedentary, exercise to the point of actual fatigue must be insisted upon, so that there is a demand on the reserve force of the body which will bring about metabolic changes. One or two Turkish baths a week will materially aid in the medical treatment, and in mild cases is almost curative in itself. Any tendency to constipation, whether due to hepatic or intestinal causes, should be corrected. The excessive dryness of the throat can be relieved by allowing an effervescing tablet containing  $\frac{1}{100}$  grain of pilocarpine to dissolve in the mouth every two hours. If, however, the secretions are excessive, a gargle of dilute hydrochloric acid, 15 drops to the ounce of water, every two or three hours, will afford in many cases almost immediate relief. Gargling the throat with water as hot as can be comfortably borne by the patient also relieves the congestion. Frequently the soreness and pain in the muscles of the throat are so



great as to demand attention. For the relief of such pain and soreness there should be applied externally chloral hydrate, 2 drachms to an ounce of soap liniment. This should be repeated to the point of producing slight external irritation. If the uric-acid diathesis is of the lithæmic form, the dilute hydrochloric acid in from 5- to 15-drop doses after meals should be given. Where the diathesis is rather of the rheumatic variety, accompanied by more marked systemic phenomena, the salicylates are preferable, and should be employed either in the form of the salicylic acid in 3- to 5-grain doses, or the freshly-prepared salicylate of sodium in 10-grain doses until the physiological effects are noted. There is a tendency of the salicylates to produce gastric disturbances. In many cases this can be avoided by ordering the salicylates after meals, with 5 to 10 drops of dilute hydrochloric acid before meals. The treatment may be alternated with benzoate of sodium, 5 to 15 grains every three hours. The patient should be instructed to drink large quantities of water; Vichy is preferable. In cases in which the pain and muscle-soreness are limited to the region of the throat 3- to 5-grain doses of salophen every three or four hours will quickly relieve the soreness and pain.

#### TUBERCULOUS PHARYNGITIS.

Primary tuberculosis of the pharynx alone rarely ever occurs. It is usually subsequent to pulmonary or laryngeal tuberculosis. As to the treatment of the condition, the method is the same whether it be primary or secondary. The prognosis, however, is more favorable in the primary uncomplicated cases than in those associated with pulmonary or laryngeal lesions. The local treatment in any case is directed toward the alleviation of the intense pain and discomfort caused by the ulceration, as, with the exception of possibly an absolutely primary local lesion, a cure can hardly be hoped for. Owing to the fact that the patient's general vitality is much lowered, together with the presence of the specific infective agent, the healing of the ulcer is a slow and almost hopeless process. For the relief of the pain, which is aggravated by swallowing, the local application of a 5 to a 10 per cent. solution of cocaine will suffice. This, however, is only palliative, and from the chronic condition of the ulcer will necessitate the long-continued use of the drug, with the necessarily bad effects, not only locally but also on the general system. I have obtained equally good results, not only for the relief of the local irritation, but also from its cleansing as well as its slightly antiseptic action, by the use of the dilute nitric acid diluted in equal parts of water and applied directly to the ulcerated areas, either by means of an applicator or in spray form. A simple therapeutic agent which gives much relief is the juice of the pineapple, used as a spray or gargle; it is

cleansing and acts as a slight astringent, also relieves the irritation and pain.

The treatment by curettement, while it may be a beneficial method, is questionable as a curative measure. For the healthy underlying structure is protected by the limiting membrane, peculiar to the specific inflammatory processes, which prevents spreading other than by continuity of tissue. Now, unless the curettement be thoroughly done and all of the infected area removed, the lymphatic system may be opened and further spreading take place. The most satisfactory plan of treatment is the thorough cleansing of the ulcer with an antiseptic alkaline solution such as—

Ry. Sodii biboratis,	
Sodii bicarbonatis,	<i>āā.</i> gr. x (0.65) ;
Acidi carbolici,	gtt. ij (0.06) ;
Aquæ,	q. s. ad fl̄j (30.0).—M.

The lesion should then be dried and an acid applied. Of the various acids used I have obtained the best results from the use of the dilute nitric or hydrochloric acid. This should be repeated two or three times a day. The application of powders such as iodoform, aristol, etc., is of doubtful value, besides being decidedly disagreeable to the patient. In the early or catarrhal stage the membrane should be cleansed and dried and a mild astringent applied, as tannin, 8 to 10 grains to the ounce ; at the same time there should be administered internally carbonate of guaiacol in 1- to 5-grain doses, three times daily. The general condition should be improved, and such constitutional treatment as is recommended in the article on Tuberculosis should be administered.

#### SYPHILITIC PHARYNGITIS.

Of the three stages of syphilis the pharyngeal manifestations are most commonly seen in the secondary and tertiary. The primary lesion is rarely if ever met with in this location. With the recognition of the character of the lesion, internal medication should be instituted ; in the secondary stage the mixed treatment, while in the tertiary the iodides alone are much more effective.

The details of the general treatment are too well known to necessitate repetition. Local treatment should consist first of thorough and repeated cleansing of the pharyngeal mucous membrane. This can be accomplished by the patient's repeatedly gargling or spraying the throat with a tepid alkaline wash as given on page 211. This should be followed by a gargle or spray of as hot water as can be comfortably borne by the patient. The areas of ulceration should be

touched every other day with nitrate of silver, 20 to 40 grains to the ounce, or carbolic acid, 10 to 20 per cent. ; or liquor ferri sesquichloridi, 4 parts ; toluol, 36 parts ; absolute alcohol, enough to make 100 parts (Löffler's solution). It is understood that the solutions given are not of the strength usually used in similar syphilitic lesions elsewhere, but the object of such strong solutions is to destroy the diseased areas and promote healthy granulation-tissue. Now from the anatomical construction of the soft parts of the pharynx, the mucous surface not being backed up by dense muscular tissue, extensive loss of structure is necessarily followed by fibrous-tissue formation with marked subsequent contraction. The use, therefore, of solutions of sufficient strength to destroy tissue will not only involve the ulcerated area, but the surrounding structure. Better results, then, will be obtained by thorough cleansing, mild local stimulation, and strict adherence to constitutional treatment, unless the ulceration involves the deeper structure, when the stronger solutions must be used to arrest the invasion. For the relief of the pain, especially during deglutition, spray of—

R. Menthol,	gr. iv (0.25),
Camphore,	gr. ij (0.13),
Vaselini (liquid.),	℥j (30.0).—M.

should be used by the patient, repeated before taking food, or at any other time when the symptoms demand its use. If the ulceration is deep and the pain severe, a 5 to 10 per cent. solution of cocaine should be used. Adhesions involving the soft palate, as well as other deformities produced by the fibrous contraction, which are most marked when following syphilitic ulceration, are now rarely if ever seen; the constitutional treatment having been instituted early in the disease prevents any such extensive local lesion.

#### FOREIGN BODIES.

The lodgment of foreign bodies in the pharynx is by no means an uncommon occurrence, and may be due to their size alone, or to both size and shape; spicule of bone and fish-bones being particularly liable to lodgment. The common sites are the lower portion of the pharynx, especially for the lodgment of large bodies, the posterolateral walls involving the palatine fold, and the supra-epiglottic portion of the base of the tongue, which, while not pharynx proper, yet forms a portion of the anterior boundary. Any paralysis or loss of sensibility of the parts will tend to the lodgment of foreign bodies. Occasionally such conditions as follicular pharyngitis or lymphatic enlargement, or scratches produced by the accidental swallowing of



such particles as a dry crust of bread, fish-bones, etc., may give rise to sensations and symptoms which simulate those produced by the actual presence of a foreign body and mislead both the patient and physician. To this may be added the imaginary foreign body described by hysterical patients.

The main point in the treatment is the location of the body, the removal after location not being usually attended with much difficulty. The irritation produced by the foreign body should be relieved by the application of an astringent such as tannin, 10 grains to the ounce, or a simple boric-acid wash, 5 to 10 grains to the ounce. This symptom is often so marked that it is difficult to persuade the patient that the foreign body has been actually removed. If much irritation and laceration has been produced a balsam preparation will relieve by remaining in contact with the tissue for considerable time and forming a protective, as well as by its therapeutic action in exerting its astringent properties. The tincture of benzoin with 50 per cent. boric-glyceride, equal parts, will give excellent results. As to the location of the foreign body, the patient should be directed to open the mouth, thus allowing all the parts to be relaxed, and inspection should be made without the use of the tongue-depressor or the laryngeal mirror. The advantage of such examination is that should the source of trouble be a fish-bone or spicule of bone or any small foreign body, the necessary muscular contraction produced by the resistance to the tongue-depressor will hide it in the palatine or faucial folds rendered tense by such contraction; whereas, if these are relaxed, the body will show plainly and can be easily removed. It must also be remembered that any violent contraction will serve to further imbed the foreign body. If from its continued presence there has been produced marked congestion, the location of the body will be still more difficult. If by direct inspection, however, the foreign body cannot be located, the pharyngeal mirror should be used, or, better, after spraying the parts with a 5 to 10 per cent. solution of cocaine, direct examination should be made with the index-finger. By a series of examinations the entire pharyngeal surface can be gone over and the foreign body located.

Foreign bodies in the pharynx are rarely of sufficient size to cause dangerous symptoms, or, if so, from their size permit of easy location and immediate removal; but if the circumstances should be such that immediate removal could not be accomplished and the patient's life be threatened, tracheotomy should be performed at once. If the foreign body be impacted low down in the pharynx involving the supraglottic region, thereby interfering with respiration, the patient should be placed on the table with the shoulders drawn to the edge and the head allowed to hang over. This will allow a direct inspection of the parts, and also aid in the removal of the foreign body, or

at least by gravity will free the epiglottis from pressure by the body and lessen the danger of suffocation. Foreign bodies involving the lateral pharyngeal wall may not be imbedded in the tissue, but merely held by the spasm produced by their presence. In such cases relaxation may be produced by spraying the part with a strong solution of cocaine allowing the easy removal of the body without laceration of tissue. In a patient seen by the writer in which a pin was held by spastic contraction of the ary-epiglottic folds, its removal without injury to the parts was accomplished in this way. The patient should be placed in the position described above so that the body when freed will not enter the larynx, but by gravity drop into the buccal cavity.

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#### DISEASES OF THE TONSILS.

UNDER this head we will treat only diseases occurring in the true tonsil. Of the acute inflammations there are many direct and associate causes. However, regardless of cause the acute inflammatory process of the tonsillar structure follows much the same course. If seen early, at the beginning of the inflammatory process, the tonsil should be touched with pure guaiacol, not only over the outer surface, but the crypts should be carefully mopped, being careful lest the guaiacol come in contact with the surrounding structure. This should not be repeated oftener than two or three times daily. Usually one or two applications suffice to abort the attack. If not effectual within twenty-four hours its local application should be discontinued. At the same time there should be given internally drachm-doses of the ammoniated tincture of guaiac in wine or milk and repeated every two hours for from four to six doses. While this treatment will usually give relief, should it fail, then instead of the ammoniated tincture of guaiac there should be substituted the tincture of the chloride of iron, 15 to 30 drops every three hours. The patient should be given at once a purgative, followed by a saline, and if from the character of the onset and symptoms a severe attack is anticipated, he should be put to bed and a 5- to 10-grain Dover's powder administered.

Should the inflammatory condition be well advanced before treatment is instituted, and if the tonsils are swollen and tense, causing difficulty in swallowing, the local treatment should consist in free bleeding by multiple punctures preferably by means of a sharp-pointed probe, as the puncture can be controlled and there is no



danger of making too deep or too free an incision, nor of wounding the surrounding structures owing to a sudden movement of the patient. Hot applications externally seem to promote resolution.

The inflammatory process involving the tonsil may be primary, or secondary to peritonsillar inflammation. When secondary the process is in reality quinsy, or beginning peritonsillar abscess. The treatment of either condition is practically the same. There should be applied externally an ointment of ichthyol and lanolin, equal parts. This should be well rubbed in, as the rubbing in itself is beneficial in promoting resolution, and when combined with the action of the ichthyol is highly beneficial. Should the inflammatory process terminate by abscess-formation the pus should be evacuated at once.

When the tonsil is enlarged and of the soft spongy variety, or the tissue œdematous, it is often difficult to make a diagnosis, by inspection and palpation, of pus-formation. This may be done by puncturing the tonsil by means of an aspirating needle, and by suction determining the absence or presence of pus. Multiple punctures may be made, for even if there is no pus present the free bleeding will be beneficial. The incision for evacuation of pus should be made in the long axis of the tonsil perpendicularly, as a transverse cut will upon healing necessarily form scar-tissue and by contraction may bind down the faucial pillars; while a longitudinal cut will not have such a tendency, or, if so, only to a limited degree. The cutting surface of the knife should be directed toward the faucial cavity, lessening the danger of wounding underlying blood-vessels and thereby avoiding dangerous hæmorrhage. By first puncturing with the needle the cutting of anomalous vessels may be avoided. Generally the pus-formation does not really occur within the tonsil proper, but within the peritonsillar tissue, necessitating a deep incision if it be made through the tonsil.

Unquestionably a number of cases of simple tonsillitis are associated with, primarily or secondarily, a rheumatic diathesis. The clinical history of the case should aid in the diagnosis. The local treatment of such cases is the same as given above, but the internal treatment should consist in the administration of such drugs as will promote elimination through the kidneys and intestinal tract. Purgatives followed by salines will relieve the intestinal tract of any engorgement and the kidney may be stimulated by copious draughts of water and by the use of diuretics. This can be accomplished by the administration of Basham's mixture in from 1- to 4-drachm doses repeated every two hours for three or four doses, and then three or four times daily. The salicylates should be given in decided doses, preferably the salicylate of soda, 10 to 20 grains every three hours until three or four doses are given, followed by 5- to 10-grain doses



three times daily. Salophen in 3- to 5-grain doses given every three hours is equally beneficial. Should the salicylates not be well borne by the patient, salol should be substituted, in from 5- to 10-grain doses. There may be combined with the salol small doses of phenacetin, which will afford some amelioration of the pain and will also lessen the irritating effect of the salol on the mucous membranes of the stomach and intestines.

Occasionally in a mild attack of tonsillitis following a severe cold from exposure ulcerated areas may form on the tonsils. When this occurs the ulcerated surface should be thoroughly cleansed, dried, and touched with an astringent solution of sufficient strength to cause slight necrosis. This can be accomplished by the application of the solid stick of nitrate of silver, care being taken not to touch the healthy tissue. After the slough forms, the granulating surface should be frequently cleansed by means of spray or gargle of an alkaline solution. The process usually terminates by healing without further treatment than the careful and repeated cleansing.

#### CRYPTIC TONSILLITIS (LACUNAR TONSILLITIS).

This variety of tonsillitis is due entirely to mechanical irritation, produced by a collection of foreign material in the numerous crypts of the tonsil. These crypts vary in size and depth, as well as in location. In them will collect the foreign material, food, etc., which from decomposition and the presence of saprophytic bacteria produces marked irritation. This variety of tonsillitis usually has a history of irregularly repeated attacks without marked constitutional symptoms. The patient usually complains of a feeling of fulness in the throat with the sensation of a foreign body and of a decidedly disagreeable taste, which is easily explained by the decomposing material which has collected in the crypts of the tonsil. The treatment consists in freeing of the crypts of the caseous material. The crypts can usually be located by hard pressure on the tongue, forcing it well down, thus causing gagging on the part of the patient, the muscular contraction forcing the tonsil out and exposing the sebaceous material. This material should be pressed out by means of a strong probe, care being taken to examine the upper portion of the tonsil to see that none of the crypts are occluded by the palatine or faucial folds, causing the retention of the sebaceous material. The tonsils should be then carefully cleansed and after the acute inflammatory processes have subsided the crypts or sacs should be incised either by means of a curved bistoury or the galvano-cautery, the object being to do away with the sac and prevent further accumulation.

## ENLARGED TONSILS.

Enlarged tonsils may be due either to an actual increase in structure or to interference with venous circulation. The large, soft, boggy variety is generally due to watery infiltration or leakage of serum from the bloodvessels into the surrounding structure, with a slow chronic inflammatory change. It must be remembered in the treatment of either condition that the age of the patient and the amount of inconvenience or irritation produced by the enlarged tonsil must be considered. In children and young adults the tonsils are normally large, and unless they give rise to irritating symptoms and interference with phonation require no treatment. This is equally true in advanced adult life. When the condition is such as to demand treatment, local applications are of little use in the fibrous or so-called hypertrophic variety. The contour of the tonsil will determine somewhat the treatment. If the surface of the organ be regular, the removal of a small portion by means of the tonsillotome will, owing to the contraction produced by the scar-tissue which necessarily follows, sufficiently reduce its size, the object of this procedure being merely to relieve symptoms without necessitating the removal of the entire tonsil, as its presence is physiological. If the surface is irregular, nodular, and pedunculated, the various projections may be removed by means of the tonsil scissors or tonsillotome.

The after-treatment in either case consists in keeping the parts thoroughly clean by means of antiseptic alkaline solutions. This can be accomplished only to a limited degree, as it is impossible to render the tissues in this location thoroughly antiseptic. For this purpose a wash of biborate and bicarbonate of soda, of each 10 grains to the ounce of water, to which has been added a few drops of carbolic acid, is to be used. In the spongy or adenoid variety local applications are highly beneficial. The surface should be thoroughly cleansed and dried and the entire tonsillar tissue, as well as the crypts, carefully mopped with dilute hydrochloric acid. This treatment continued every other day, together with attention to the individual's general condition, will usually afford relief. There is in some cases, however, a tendency to a recurrence of the condition. If then the application of dilute hydrochloric only gives temporary relief, linear cauterization should be resorted to. The line of cauterization should be made in the long axis of the tonsil, thereby lessening the tendency to involvement of the faucial pillars.

In the cases in which the tonsils are enormously enlarged, boggy, and filled with crypts presenting a ragged and discharging surface a portion of the tonsil should be removed by means of the tonsillotome.

Occasionally cases are met with in which from some acute inflam-

matory process involving the tonsillar and peritonsillar tissue adhesions have taken place between the faucial pillars and the tonsil, producing, from the contraction which follows such adhesions, a sensation of constriction and discomfort in swallowing, with alteration in the voice. In such cases relief can be obtained by the breaking up of the adhesions and thoroughly freeing the tonsil, without necessitating the removal of the tonsillar tissue.

#### CASEOUS TONSILLITIS.

This variety is quite similar to cryptic tonsillitis, and is largely mechanical in origin. Either from pre-existing inflammatory processes or from the enlarged tonsil with its deep crypts, which have been altered by catarrhal inflammatory processes, pockets of varying size form here and there over the tonsil. In these pockets secretion and particles of food accumulate, which in themselves act as foreign bodies, and by the presence of bacteria of fermentation, as well as pathogenic micro-organisms, an irritation is set up, which, in turn, causes inflammatory processes in the surrounding structure. Frequently there will be discharged from these crypts minute masses of foul-smelling caseous material.

**Treatment.**—The pocket or crypt should be freely opened, carefully mopped with carbolic acid, or thoroughly curetted, so that in the healing process their entire obliteration will occur. Occasionally pockets may reform during the process of healing. Should this happen the same treatment should be repeated.

#### LINGUAL TONSIL.

This mass of conglomerate glands, situated as they are right above the attachment of the epiglottis at the base of the tongue, are frequently the site of acute inflammatory processes, and may be the cause of a continued irritating cough or of constant clearing of the throat. The irritation of the lingual tonsil may be purely a local process or associated with an inflammatory condition of adjacent structures or by some systemic lesion. For the relief of the engorgement and swelling of the gland a 3 per cent. solution of chloride of zinc should be applied once daily. Frequently a troublesome cough which has resisted all efforts at relief by cough mixtures will yield after a few applications to this apparently innocent gland structure.

#### VARICES.

The veins at the base of the tongue may be uniformly dilated and show as bluish, tortuous cords. Occasionally they are markedly irregular, showing saccular dilatation, which appears above the surface, and which may rupture and cause severe hemorrhage. This



vasomotor neurosis in females often accompanies menstrual disorders. It is especially likely to occur during pregnancy or the menopause. It may also be the result of alcoholism. These enlarged veins may produce peculiar subjective sensations; the most common is that of a moving body in the throat.

**Treatment.**—The condition is usually dependent upon some interference with venous circulation, and is often associated with intestinal lesions or lesions of the heart, kidney, or liver. Treatment should first be directed to the relief of these underlying causes. Should this fail to give relief the dilated vessels should be punctured by the galvano-cautery. The rupture of these saccular dilated veins will account for some of the so-called idiopathic hemorrhages. The act of spitting blood is most alarming to the patient; and when such has occurred, in endeavoring to locate the site of hemorrhage, the dilated vessels at the base of the tongue should never be overlooked.

As a point in differential diagnosis in cases of hemorrhages from the dilated vessels at the base of the tongue there will be absolute absence of lung symptoms.

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## DISEASES OF THE LARYNX.

**Autoscopy.**—As supplementing the laryngoscope mirror in the examination of the larynx and trachea, we have the autoscope with the added claims of direct inspection and view of the posterior walls of these important structures. Kirstein of Berlin is the inventor and perfecter of this instrument, which consists of three parts: the spatula, the sliding hood, and the handle. The spatula is a slightly concave metal plate 14 cm. in length, which is in the main straight but is slightly curved downward toward its laryngeal end, where it has a somewhat thickened lip and rounded edges to prevent injury to the parts with which it comes in contact. The sliding hood serves the purpose of keeping the teeth, the lips, and in man the mustache, away from the spatula, leaving sufficient space between the two plates for inspection and for the introduction of any instrument. The handle is the electroscope of Casper, which by means of its small electric light illuminates the entire length of the spatula and the parts beyond. (See Fig. 315.)

The two main conditions upon which the autoscope depends in laryngeal inspection are, first, that firm pressure upon the root of the tongue and the median glosso-epiglottic ligament will elevate the

epiglottis, thus giving the desired view ; and, second, that by proper position the laryngo-tracheal tube may be made to form a straight instead of an angular line with the axis of the buccal cavity.

The technique of examination is as follows : The physician stands

FIG. 315.



before the patient, who is seated in a chair with the neck slightly inclined forward. The autoscope is introduced in exactly the same manner as applying an ordinary tongue-depressor. A view of the buccal cavity and oro-pharynx is thus obtained. By pushing the spatula farther backward, elevating the handle, and pressing firmly downward and backward on the base of the tongue, being careful not to use the upper teeth as a fulcrum, the lower part of the pharynx, the larynx, and if the patient's position be correct the trachea, may be seen. The actual tissues appear in autoscopy, not their image, with a remarkable distinctness of anatomical detail. Above all, the posterior wall of the larynx, the interarytenoid fold, which can be examined only with great difficulty by the aid of the mirror, can be inspected almost in a surface view ; and the possibility of inspecting the whole of the trachea and the beginning of the bronchi should alone be sufficient to ensure for autoscopy recognition among diagnostic resources.

#### ACUTE LARYNGITIS.

An acute inflammatory process involving the mucous membrane of the larynx is not always a serious condition, yet, from its location and the tendency to oedema with the subsequent interference to respiration,

laryngeal structure, prompt surgical interference is necessary. The œdematous tissue must be punctured. The puncturing is better than scarifying, as there is less danger of causing any serious hæmorrhage and there is also less laceration of tissue. It must be remembered that in œdema the engorgement is not a vascular one, but a watery infiltration of the perivascular structures, and that such exudation somewhat relieves the engorged vessels. Puncturing, then, will relieve this watery infiltration, while scarifying will accomplish the same result but with the added evil of more extensive laceration. This procedure may be followed by the application of mild astringents such as liquor ferri persulphatis, 5 to 10 drops to the ounce, or argenti nitras, 2 to 5 grains to the ounce.

If the œdema be rapid and well advanced and the danger of suffocation imminent, immediate intubation or tracheotomy is indicated.

There is a tendency after the subsidence of the acute attack to huskiness or even complete loss of the voice, lasting for several days or weeks. For the relief of such a condition there should be administered internally 5-grain doses of the benzoate of sodium; or if there is associated any perversion of the stomach secretions 8- to 10-drop doses of dilute hydrochloric acid should be given in water after meals.

General medication is not usually indicated in acute laryngitis, although there may be associated conditions necessitating special attention. For the distressing irritating cough there may be administered an anodyne, as codeine sulphate in doses of gr.  $\frac{1}{2}$  to  $\frac{1}{8}$ , repeated only to the point of relief of the symptom. In individuals of a rheumatic or gouty tendency an alkali should be given. In such cases a 5-grain effervescent citrate of lithium tablet every three hours in half a glass of water, or preferably the carbonate of lithium in the same dose, should be given. If the vocal bands are markedly involved in the inflammatory process, causing complete loss of voice, absolute rest should be insisted upon.

#### ACUTE LARYNGITIS IN CHILDREN.

Simple acute laryngitis rarely ever occurs in children, the acute inflammatory process either being classed under the spasmodic condition known as spasmodic croup or under the membranous variety of inflammation. While all membranous inflammatory processes are not true diphtheria, yet the symptoms produced by the actual membrane, as well as the early treatment of the case, is precisely the same as in true diphtheria. For the membranous conditions, then, the reader is referred to the article on Diphtheria.

**Acute Laryngitis or Spasmodic Croup.**—While the anatomical relations of the structure of the larynx in children do not differ materially from those found in the adult, yet the measurements or



dimensions are smaller, and there also exists a vascularity of the mucous membrane lining the larynx which is peculiar to children. Any condition bringing about sudden congestion, associated with the narrowness of the rima, will give rise to alarming and distressing symptoms. It must also be remembered that in children reflex excitability is more marked than in adults. That sudden atmospheric changes with exposure to cold and dampness is one of the important exciting etiological factors is borne out by the fact that the condition is most likely to occur in the spring and fall months. Beside these the irritation produced by the inhalation of irritating vapors, fumes, or dust, or an associated gastro-intestinal irritation, may be exciting factors. The condition is sudden in onset, rapid in course, and terminates as rapidly as it began.

As this condition presents no premonitory symptoms, the child usually waking at night with a fully developed case of spasmodic croup, the treatment should be first directed to the relief of the actual spasm itself, and after this has been relieved the underlying causes should be investigated. Should there be much secretion present and accumulation in the larynx an emetic should be at once given, such as ipecac in the form of the wine or syrup, in a dose determined by the age of the child and the urgency of the symptoms. Prompt emesis can be obtained by the hypodermic administration of apomorphine, but it should only be employed in extreme cases because of its depressing effects. In cases in which there is very little accumulation of fluid within the larynx and yet spasm is brought about reflexly by gastric irritation, an emetic is also useful as a remedial agent. The continued hot bath and the use of hot vapors are successful measures in promoting relaxation and free diaphoresis, and should always be employed. After the relief of the paroxysm attention should be directed toward the exciting factor and treatment directed against its return. Any gastro-intestinal irritation should be corrected, and the child should be kept in an equable temperature and care should be taken that the air of the room be of the proper humidity and that it be free from any irritating fumes such as are generated by improperly regulated heaters or the ordinary coal-stove.

#### SUBACUTE LARYNGITIS.

This condition is usually secondary to the acute. The conditions vary much in individual cases and the successful treatment will depend on a thorough knowledge and close study of the causes underlying each case. The thickened inflammatory condition involves the submucosa with infiltration into the perivascular structure. This condition continued produces perverted secretion with annoying dryness and distressing hoarseness. Should there be any irritating or exciting

causes, such as smoking, inhalations of dust, etc., the removal of these exciting factors is the first thing to be done in the treatment of the case. The local application should consist of an alkaline spray, which should be as hot as can be comfortably borne by the patient. Warm boric-acid solution, 5 to 15 grains to the ounce, is highly beneficial although the benefit derived by the application of the warm water alone is to my mind quite as great as when the acid has been added. This should be repeated six to eight times daily, but if the condition exists in an individual whose profession necessitates the use of the voice, the warm spray should not be used within three or four hours of the time of the continued employment of the voice. As far as possible though, in individuals suffering from this condition, rest of the vocal bands—at least from any continued effort—should be insisted upon.

In individuals in whom the dryness is due to a deficiency of secretion the internal administration of drugs which increase secretion will produce the best results. However, it must be carefully ascertained that there is no lesion elsewhere which is the direct cause of the laryngeal complication. For example, such conditions as valvular heart disease or fibroid lung, or any lesion of the circulation with a tendency to cyanosis of the mucous membrane, will bring about just such a condition of dryness in the larynx. If such condition exist, local or internal medication directed to the laryngeal structure alone will be of little value. For the increase of secretion in such cases as are not dependent on the causes mentioned above there should be administered internally, every three hours, 5-grain doses of the benzoate of ammonium to be given in half a glass of water; its irritating effect on the mucous membrane of the stomach can be avoided by discontinuing its use every third day. In cases where the drug is to be used for long time this omitting of the dose every third day should be part of the directions for its use. If the condition is well advanced and bordering on a chronic laryngitis, better results will be obtained by the administration three times daily of 5 grains each of iodide of sodium and potassium, observing the same precaution as advised in the use of the ammonium salt.

In the subacute variety following a catarrhal process, in which the hoarseness in speaking is produced by the accumulation of secretion about the vocal bands and within the larynx, the best results will be obtained by the internal administration of 1- to 3-grain doses of carbonate of guaiacol in pill form in plenty of water. This seems to relieve the condition by thinning the viscid secretion and by its stimulating action on the muciparous glands and circulation. By such action the parts are relieved of the irritating secretion, and normal circulation and secretion are established. In cases in which the secretion is exceedingly tenacious, before the guaiacol is given or in com-



bination with it there should be administered terpin hydrate in 5- to 15-grain doses ; or, better, the elixir terpin hydrate in teaspoonful-doses every two hours ; any irritating effect of this drug on the mucous membrane of the stomach can be avoided by giving it in a large amount of water. This should be taken every three hours until there is marked effect on the secretion, and then two or three times daily. Should this excess of secretion, although of a fairly normal character, be continued, the administration of the above drugs should be discontinued, and there should be given three or four times daily gr.  $\frac{1}{4}$  of morphine, or, better, gr.  $\frac{1}{2}$  of codeine.

In all cases of laryngitis, either acute, subacute, or chronic, attention should be devoted to the gastro-intestinal tract, and such conditions as tend to cause deficiency in glandular secretion and venous stasis should be relieved. One of the best agents for the depletion of the intestinal circulation and for its derivative action on laryngeal structures is sulphate of magnesium in large doses. It must be remembered that frequently acute or subacute laryngitis is caused by the spreading of the inflammatory process by contiguity and continuity from some neighboring structure or part, as from the pharynx, œsophagus, tonsils, and naso-pharynx. In such cases the active treatment should be directed toward the offending structure as well as the medication of the larynx itself.

Inhalations if properly administered are of some benefit. A teaspoonful of the tincture of benzoin placed in a cup of boiling water and the medicated steam inhaled just before retiring will often relieve the distressing cough and irritation so often increased when the recumbent position is assumed. Inhalations should not be used, however, except when the individual is confined to his room or just before retiring, as otherwise there is danger of catching cold.

#### CHRONIC LARYNGITIS.

Of the chronic inflammatory processes involving the laryngeal structures in addition to the chronic specific inflammations there are two principal ones : first, simple chronic laryngitis ; secondly, dry laryngitis or laryngitis sicca.

**Simple Chronic Laryngitis.**—Simple chronic laryngitis may be secondary to an acute condition of the larynx, but the process is usually secondary to or associated with lesions of the respiratory tract above the larynx, and the treatment should be primarily at least directed to the relief of the existing lesions rather than directly to larynx itself. In all catarrhal conditions of the nose, naso-pharynx, and pharynx, with the consequent accumulation and irritation produced by such accumulation there must necessarily be produced continued irritation of the laryngeal structure. Repeated and thorough



cleansing of such affected parts should be strictly enforced. For its cleansing and detergent effect bicarbonate of potassium and bicarbonate of sodium, of each 10 to 15 grains to the ounce of warm water, three or four times daily, as a douche or by means of a spray, should be used.

For the treatment of the catarrhal condition after cleansing there should be applied directly to the structures a mild astringent. For this purpose a solution of sulphate of copper or nitrate of silver, 5 to 10 grains to the ounce, may be employed and intra-laryngeal applications made. When applied by means of cotton, care should be taken that no excess of the solution be used, as the pressure employed in the application may cause the solution to run over healthy structures and down into the trachea. Equally good results will be obtained by the application by means of a spray of a 3 per cent. solution of alumnol; although a comparatively new drug, I have found it highly beneficial in such conditions.

Besides the correction of any nasal irregularities, attention must be given to the individual's personal habits as regards the use of tobacco and alcohol. As climate and occupation may have to do with the case as etiological factors, temporary or possibly permanent change from such exposure should be insisted upon. It must be remembered that the condition may be dependent upon or aggravated by gastro-intestinal, hepatic, and even renal lesions. In such cases treatment should be directed toward the offending organ. If the general health is at fault, constitutional treatment should be instituted. Of the therapeutic agents administered for the direct effect on the mucous membrane, if the secretions are profuse yet tenacious, benzoate of sodium three or four times daily in 5-grain doses is the best. If the secretions are scanty and there is a tendency to dryness of the membrane, iodine gr.  $\frac{1}{8}$ , phosphorus gr.  $\frac{1}{100}$ , bromine gr.  $\frac{1}{8}$ , in sherry wine (compound wine of iodine), in plenty of water three times daily, is useful.

#### DRY LARYNGITIS.

Dry laryngitis is usually associated with a similar condition of the pharynx, and possibly nasopharynx and nares; in other words, a condition, either local or systemic, which would bring about a similar condition in the structure above is responsible for the laryngeal condition. The condition, however, is quite rare as occurring in the larynx, which is possibly due to the fact that the blood-supply is different, and that the larynx is better protected from irritating foreign material.

**Treatment.**—The treatment should be directed toward the correction of any constitutional diathesis, with internal medication specially directed toward increasing glandular secretion. This can best be ac-

complished by the internal administration of phosphorus ( $\frac{1}{100}$  grain), iodine ( $\frac{1}{8}$  grain), bromine ( $\frac{1}{8}$  grain), in sherry wine, three times a day after meals. Equally good results may be obtained by the administration every three or four hours of 5-grain doses of terpin hydrate. If there is any conjoined bronchial irritation, 3-grain doses of carbonate of guaiacol should be administered. For its action on glandular secretion there should be administered, night and morning, tablespoonful-doses of the granular effervescing phosphate of sodium.

Abnormalities in the nasal cavity and nasopharynx should be corrected. For the relief of the irritation caused by the accumulated dried material within the laryngeal structures direct medication is essential. There should be applied directly to the surface, by means of inhalations, sprays, or applicator, dissolving emollient solutions.

To dissolve the secretions, inhaling the steam from boiling water, to which has been added 1 to 3 grains of carbolic acid to the pint, is admirable. Five grains of sulphocarbolate of zinc to the pint of water are equally beneficial. Where the irritation is marked great relief can be obtained by inhaling the fumes of compound tincture of benzoin (1 drachm) and chloroform (10 drops), on which is poured a pint of boiling water. Stimulating solutions should be applied directly to the larynx by means of an applicator. The irritation of the membrane by the introduction of the applicator will be productive of no harmful results; in this condition a slight irritation is really beneficial. After removal of the inspissated mucus the parts should be lubricated with a bland, oily solution, such as liquid albolene or benzoinol, to which have been added 6 drops of the oil of sandalwood to the ounce. This solution, applied at intervals of three or four hours, will relieve the patient of the distressing symptoms produced by drying of the secretion. For its stimulating action there should be applied, with the aid of the laryngeal mirror, directly to the laryngeal structure, a 1 to 3 per cent. solution of chloride of zinc. This should be done quickly after the patient has taken a full inspiration. Highly satisfactory results can be obtained from the local application externally of petroleum. This should be rubbed in, and a saturated flannel cloth should be wrapped around the neck during the night.

#### CEDEMA OF THE LARYNX.

Cedema of the larynx may be produced in a number of ways. It may be associated with an acute laryngitis, may be a result of inflammatory processes involving the pharyngeal, tonsillar, or peritonsillar structure, or may be produced suddenly by the inhalation



of acrid vapors or irritating fumes. Such processes will produce an acute condition, yet it must be remembered that chronic specific inflammations also may bring about a sudden œdema of the larynx—as, for example, in syphilis and tuberculosis, in which the blood-vessels are involved and there is an œdematous infiltration of the adjacent structures. This is also true in malignant diseases of the larynx. The irritation caused by foreign bodies not within the larynx, but in the œsophagus or the pharyngeal structure, may produce a sudden œdema of the larynx. The treatment should first be directed toward the relief of the œdema, whether it be due to an acute phlegmonous inflammation, passive congestion, irritation from foreign bodies, or irritating vapors, and then the curative treatment or the treatment to prevent its recurrence should be addressed to the underlying cause.

Besides the irritation caused by disease processes in the structures immediately adjacent, it must be remembered that œdema of the larynx may be caused by cardiac and pulmonary conditions producing cyanosis of the mucous membrane, also that renal and hepatic lesions, especially the fibrous changes, through their action on the heart, may bring about the same condition. In all such cases the constitutional treatment should be directed toward the offending structure, to prevent, if possible, a recurrent attack.

For the immediate relief of the œdema puncturing or scarifying should be done at once; the patient should be given a saline cathartic and kept in a warm room in an atmosphere thoroughly surcharged with moisture, and a diaphoretic administered. The punctures and scarifying should be done under the same rules as mentioned under Acute Laryngitis with subsequent œdema. The application of astringents after puncturing are rarely necessary if the above method has been carried out. However, should it be necessary to apply astringents, 10 grains to the ounce of nitrate of silver, or a 10 per cent. alumnol solution, should be used. As a rule, if the puncturing be followed by the application of a 20 to 30 per cent. aqueous solution of ichthyol, the tendency to recurrence is markedly diminished, as the ichthyol promotes rapid resolution. In all cases of œdema associated with renal, cardiac, or hepatic disorders free daily movements of the bowels must be secured until the condition is relieved. The application of cold in the form of ice-bag, or Leiter's coils, or the application of leeches may be of service in arresting further œdema, as the effect produced by such procedure is largely limited to the blood-vessel itself, while the condition to be relieved is entirely a perivascular one and consists of a watery infiltration of the structures involved. Such procedure then would be of service only by toning up the vessel-walls and in this way preventing further leakage, but



would not affect the serum already poured out into the perivascular tissue.

In cases of sudden œdema which are usually associated with acute suppurative processes, it may be so sudden and rapid that the patient is in danger of suffocation. In these instances intubation or tracheotomy should be performed at once. Tracheotomy is preferable to laryngotomy only because the opening in the air-passages is at a point away from the inflammatory process. In œdema of the larynx associated with syphilitic lesions it must be remembered that the administration of the iodide of potassium, while not actually producing the condition, tends to complicate and aggravate it and should be discontinued.

œdema may be associated with either perichondritis or chondritis as causative factors, and when the diagnosis is assured the treatment should consist, early in the condition, first, in the application of the aqueous solution of ichthyol internally, externally an ointment of ichthyol and lanolin equal parts. Should the œdema be threatening and require immediate relief it will be necessary to resort to scarification and puncture. Involvement of the cartilage or pericartilaginous structures is rarely associated with simple acute inflammatory processes, but usually with infectious diseases, frequently following typhoid fever.

#### SPECIFIC INFLAMMATIONS.

Under the specific inflammations the varieties which we commonly have to deal with in the laryngeal structure are syphilis and tuberculosis, although glanders may also occur.

**Glanders of the Larynx.**—This is a rare condition and is never limited to the laryngeal structure, and when such involvement takes place it is in the chronic form. One case was seen by the writer in which this condition involved not only the pharyngeal and nasopharyngeal but also the laryngeal structure. The diagnosis of such a condition can be established by bacteriological investigation, and unless made early complete removal is almost impossible. Outside of surgical interference the administration of iodide of potassium pushed to its physiological limit will be of benefit. The treatment with melanin may be productive of good results, but not sufficient experience has been reported to warrant its recommendation as a curative measure.

**Tuberculosis of the Larynx.**—Tuberculosis of the larynx usually occurs secondary to pulmonary tuberculosis, although primary involvement of this part may occur. The treatment in either case is the same, although the prognosis in the primary condition is more favorable than when dependent upon pulmonary lesion. Much can be

done by regular systematic local treatment to retard the progress of the disease, and possibly in some cases a cure may be effected. As a rule, the condition when presented for treatment has advanced to ulceration. Repeated and thorough cleansing of the part should be instituted at once. This can best be accomplished by spraying the parts with hydrogen peroxide (15-volume), followed by an alkaline antiseptic solution such as biborate and bicarbonate of sodium, of each 10 grains to the ounce of cinnamon-water and distilled water equal parts. After cleansing and drying, the ulcerated surface should be carefully touched with dilute nitric or hydrochloric acid. The frequency of such applications must be left to the judgment of the physician based on his knowledge of the case, but as a rule once daily is sufficient. If the ulcer is deep, curettement under cocaine or eucaine anæsthesia should be done. The curettement should be thorough, as it must be remembered that the tubercular area is surrounded by a limiting membrane, and unless the infected tissue be thoroughly removed the breaking up of the protecting membrane may be the means of rapid dissemination of the tuberculous infection through the lymphatics or blood-channels. In cases in which the ulceration is not far advanced, or the process is somewhat limited, after the cleansing and drying of the surface there should be applied directly to the ulcerated area, either by means of spray or applicator—

Ry. Creasoti,	ʒj (4.0);
Olei picis liquidæ,	gtt. xx (1.3);
Alboleni (liquid.),	f ʒss (15.0)—M.

Castor oil may be substituted for the albolene on account of its viscid and tenacious properties, but I find it productive of no better results.

#### TUBERCULAR LARYNGITIS.

Intralaryngeal injections of creosote and guaiacol are productive of good results, at least alleviating, if not curing, all cases.

James Donelan, of London, has reported success in the treatment of several cases of tubercular laryngitis by injections of guaiacol, for which purpose he had devised a special form of syringe. It consists of a steel barrel mounted on a modified handle. Instead of a piston-rod and leather piston, there is a steel plunger graduated in minims and fitting accurately to ensure the propulsion of fluids. It is easily sterilizable. The technic of the operation is as follows: The larynx is first cleansed with an antiseptic spray; then the needle of the syringe is inserted at the desired site, and 1 minim of pure guaiacol is injected into the floor of the ulcer or most promi-

ment part of the infiltration. The local reaction is slight, and is easily controlled by rest and by sucking ice. The injections are continued at intervals of a week. There is no danger or inconvenience from the treatment, which is attended with gratifying results, particularly as regards the relief of dysphagia.

The deep injections of alcohol, beginning with a weak solution and gradually increasing the strength to absolute, act favorably in some cases. One-tenth of 1 per cent. formaldehyd with 2 per cent. cocain, locally applied, had a decided effect in lessening the tendency to spread.

The most distressing symptom experienced by the patient is the constant pain, which is especially aggravated by swallowing. A number of agents are recommended for the relief of this condition, no single remedy being efficacious in all cases. The simplest and the one from which I have obtained the best results is the juice of the ordinary pineapple applied by means of spray or applicator. This can be frequently repeated without any ill effects. Cocaine in a 6 to 10 per cent. solution as a spray will give relief, but it is not lasting and requires frequent repetition. Inhalation of benzoin gives partial relief. Should there be dryness of the parts, a solution of—

R. Menthol,	gr. iv (0.25);
Olei santali,	gtt. iv (0.25);
Alboleni (vel benzoinol),	f ʒj (30.0).—M.

will lubricate the surface and relieve the irritation. Cracked ice acts favorably and gives some temporary relief. Liquid diet should be instituted and no irritating condiments used. In the advanced stage of the disease in which the treatment is purely palliative, narcotics may have to be administered to relieve the intense suffering.

The constitutional treatment should consist in the administration of such drugs as will improve the general nutrition, as cod-liver oil, iron, hypophosphites, or the arsenical preparations, and if the tubercular tendency be recognized early, the patient should be placed under suitable climatic conditions.

**Syphilis of the Larynx.**—Under this heading is included all conditions brought about by the inoculation of the specific virus either hereditary or acquired. The diseased condition of the larynx is usually manifested in the secondary or tertiary form. Primary lesions rarely, if ever, occur in the laryngeal structure. The laryngitis of secondary syphilis presents very little that is characteristic, the common lesion being the tertiary one. The primary lesion presents no indication for treatment; the better rule is to follow the well-established practice of waiting for secondary manifestations. The mucous



patch which occurs in the larynx is usually limited and single and yields promptly to internal medication. If, however, local treatment should be indicated the lesion is treated exactly as a mucous patch elsewhere. In the superficial ulcer the parts should be thoroughly cleansed, following the same method as given under tuberculous lesion of the larynx, and then touched with 20 to 40 grains of nitrate of silver to the ounce of water. Good results may be obtained, when the ulcer is accompanied by an acute inflammatory process involving the surrounding tissue, by insufflation, after thorough cleansing, of pyoktanin (1 to 2 drachms to the ounce of stearate of zinc). The objection to the use of powders is the danger of drawing the powder farther into the respiratory tract and producing irritation. This can be obviated by the patient taking a deep inspiration and holding the breath during the insufflation. By so doing the first respiratory act after the application will be one of expiration.

In the deep ulceration due to gummatous degeneration the same course of local procedure as followed in the secondary lesions should be observed. In the secondary and tertiary stages, while the local treatment is of importance, yet the internal medication is the prime factor, and the system must as soon as possible be brought completely under anti-syphilitic influence. In the second stage the mixed treatment is to be used; the iodide of potassium alone in the tertiary lesion. The plans for such treatment are too well known to necessitate repetition. (See article on Syphilis.)

Much has been written in regard to the treatment of syphilitic stenosis due to fibrous-tissue formation after ulceration. This should not occur if, upon early recognition of the lesion, proper, prompt, and energetic anti-syphilitic treatment has been instituted, and it is only in neglected or exceptional cases that such lesions exist. Once fibrous-tissue formation has taken place no amount of internal medication will benefit it. The resulting cicatricial tissue presents the well-known stellate scar with the peculiar contraction and alteration of the contour of the part. The division of the stellate bands may relieve somewhat the condition, but the incision that divides the bands brings about another inflammation with its subsequent contraction. Various dilators are recommended, and no doubt produce some beneficial results, but it must be remembered that we are dealing with an inflammatory fibrous tissue, and while dilatation may retard and somewhat arrest the contraction it cannot entirely remove the stenosis. The contraction may go on to such an extent as to necessitate, in order to prolong the patient's life, the performing of tracheotomy.

## TUMORS OF THE LARYNX.

Owing to the histological structure of the larynx it is possible to have occurring there any variety of tumor, either adult or embryonic, of either type of tissue—epithelial or connective. The benign or adult tumors occurring within the larynx or involving the vocal bands are always of grave import, not only from the irritation produced by the presence of such a tumor—which in itself acts very much the same as that of a foreign body, interfering with phonation and respiration, such interference depending upon the size and location of the tumor—but also from their tendency to malignant change. It is a well-known clinical fact that benign neoplasms which are subject to chronic irritation or trauma may become the site of malignant growths. This does not mean that the benign growth is by some unexplainable process transformed into a malignant one, but that the former is the site of the malignant development just as any other adult structure may be the site of such development. Of the adult tumors occurring within the larynx or involving the cords the papilloma is possibly the most frequent. This is an adult epithelial neoplasm, and contains both connective and epithelial types of tissue. From the chronic irritation, then, this simple benign tumor may be transformed into a malignant or carcinomatous growth. Of the adult connective-tissue tumors likely to occur in this location the simple myxoma or the fibro-myxoma are the most common.

The attempt at removal of such tumors by the application of acids or other irritants may bring about malignant change. As by trauma, and the application of such solutions as chromic acid, or the galvanocautery which practically amounts to trauma, this benign connective-tissue tumor may become the site of a malignant or embryonic connective-tissue growth—sarcoma. The treatment, then, of benign tumors involving the laryngeal structure should be their prompt removal through surgical interference, either by cutting forceps, cold snare, or especially curved scissors, care being taken to produce as little laceration of the healthy structure as possible and yet obtain the complete removal of the growth. As a rule, the removal of benign laryngeal tumors by the intralaryngeal method can best be accomplished by the Sherwell or Grant laryngeal scissors, the advantage of the instrument being that it occupies very little space and the cutting-blades are concealed and can be opened to any degree necessary for grasping a tumor. The instrument also cuts with a free edge, producing very little laceration of tissue. For small tumors on the cords this instrument is unquestionably the best. Another advantage is that the cutting-blades can be set at any angle desired.

In all cases of laryngeal tumors absolute rest of the voice should



be insisted upon for at least ten days before the operation. The advantage of insisting upon absolute rest of the voice lies largely in the fact that it relieves the tension and congestion and reduces the irritation and swelling to the minimum, so that the size of the tumor will not be overestimated owing to the inflammatory swelling. Even under cocaine anæsthesia an intralaryngeal mucous membrane is extremely sensitive, and much better results can be obtained by training the larynx to the introduction of the instrument before attempting the operation. This can be done by quickly passing the instrument in and out of the larynx, thereby getting the location and angle for the particular individual, and during these manipulations, should everything be favorable, the operation can be performed at once.

Malignant growths will necessitate a major operation, such as the removal of a portion or the entire laryngeal structure. This has been successfully done, and the individuals were for a time at least freed from any manifestation of the growth. At the same time, owing to the rich lymphatic supply, there is quite likely to be a return of the tumor, or rather, often, a failure of complete removal. As all varieties of the carcinoma spread by the lymphatics, no fixed or definite line can be drawn as to limit of the invasion. Sarcoma occurring in this region is equally liable to dissemination, although through the blood-channels and not by the lymphatics. In either case with the invasion of the surrounding structure its complete removal would necessarily involve the important and vital structures of this region. Partial removal, then, may afford some temporary relief, but a permanent cure cannot be expected.

#### FOREIGN BODIES IN THE LARYNX.

The introduction into the larynx or the trachea of a foreign body is an accident at once alarming and at the same time exceptionally dangerous to life. Foreign bodies interfere with respiration in several ways: first, by size; second, by size and shape combined; third, by their composition—for certain substances, as wood, cork, grains of corn, etc., owing to the absorption of moisture increase in size after introduction, thus causing obstruction and increasing the tendency to œdema, either in the larynx primarily, or secondarily from adjacent structures or the œsophagus by being lodged in those structures. The commonest mode of entrance is through the mouth during ill-timed or forcible inspiration, either while laughing, eating, or upon being suddenly startled or frightened. Whether the body be caught in the larynx or swept immediately and directly into the trachea or bronchi depends upon its size and shape. Large and irregularly shaped articles being unable to pass through, are caught and held in some part of the larynx.



The history of the case often leaves no room for doubt as to diagnosis. But should any exist, the direct inspection by the use of the laryngeal mirror (after overcoming spasm, if it exist, by a 10 per cent. cocaine solution), digital examination, or auscultation will soon reveal the location of the offending article.

The best method of determining the exact position of the foreign body encysted or free in the upper respiratory tract is the Röntgen rays. Not only photography, using the Röntgen rays, but also the cryptoscope with the fluorescent screen has proved eminently satisfactory, not only in the locating of foreign bodies, but also in determining alteration in the bony and cartilaginous structure, such as necrosis of bone and ossification in the cartilages. The transparency to the rays of the cartilaginous matter of the larynx, however, renders it necessary to draw up a projected chart of this region for the localizing with exactitude of the actual position of the foreign body. The pain due to a foreign body is often referred to a point other than its actual location. By determining its exact position by the x-rays, the false data of this misleading symptom can be at once set aside.

In a number of cases the foreign body has been spontaneously expelled through the mouth; should this not occur, however, an effort should be made at once to extract it through the natural passages. The special means and instruments to be employed to accomplish this end differ with each case, but the position to be assumed by the patient while the effort is made to extract the foreign body is identical in all cases. He should lie on his back on a table with the shoulders at the edge, the head hanging over, with the mouth wide open. By the adoption of this position—1. The physician is enabled to examine the patient with at least as much ease as in any other posture, with the added value of better control of his movements; 2. Respiration is not interfered with; 3. The foreign body if it be detached, whether by efforts of the examiner or spontaneously, cannot drop farther into the respiratory tract, but must of necessity fall into the mouth.

Sternutatories, emetics, and the like may be of value and should be administered. Should necessity require it, the respiratory tract should be opened in the position most favorable for the removal of the body. Intubation if attempted should be done with exceeding caution, as there is great danger of further imbedding or pushing the body down into the bronchi. Usually the symptoms produced are so sudden and of such a threatening nature as to demand immediate relief, so that often the many convenient and useful instruments devised for the removal of foreign bodies are not at hand. The multiplicity of instruments devised proves that no single one is applicable

in all cases. A simple improvised instrument is the wire loop, using several loops and passing them well down into the larynx, and by twisting the wires on removal the foreign body may become entangled in the coils.

The foreign body may be impacted and retained by muscular spasm, especially if above the true bands. If the patient be placed in the position given above and the parts sprayed with a 20 per cent. solution of cocaine, relaxation may be accomplished and the body drop out by gravity. Smooth and metallic bodies may be expelled by inversion of the patient.

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